DECEMBER 1953

TWO SHILLINGS

Wireless World

Radio · Electronics · Television

FORTY-FOURTH YEAR OF PUBLICATION

BI Callender's

CELLULAR POLYTHENE

in NEW T/V DOWNLEAD developed by

BICC

A low-loss downlead will be necessary in many areas for reception on Band III T/V. Using Cellular Polythene as a dielectric, BICC have developed such a downlead having an attenuation approximately 30% less than the present standard service area type with only a small increase in diameter . . . one of the many ways in which BICC research and development engineers have helped to supply the needs of the telecommunication industry.

If this development can assist you—or you are just interested—please write for further information.

BRITISH INSULATED CALLENDER'S CABLES LIMITED
21 BLOOMSBURY STREET LONDON W.C.1

A remarkable photograph by Eric Hosking, F.R.P.S. of a newly hatched Avocet.

JUST HATCHED

An entirely new "Avo" Signal Generator has been developed and production will commence in the near future. The new instrument has a wide frequency coverage and has been specially designed to meet the requirements of the existing and proposed new Television and Frequency Modulation stations.

- **Directly calibrated in frequency with a continuous band from 5 to 230 Mc/s over a scale length of approximately 60 inches.**
- **A special device enables precise frequency setting and discrimination over a narrow band anywhere within the main frequency range.**
- **A separate expanded scale covers the frequency modulation stations.**
- **A single switch selects CW, sine-wave modulated AM, square wave modulated AM and frequency modulated signals.**
- **The instrument is fitted with a comprehensive attenuator system.**
- **R.F. signal can be modulated from an external source.**
- **Internal modulation signals available for L.F. testing.**

The Avocet, a rare species of bird which has returned to breed in England after an absence of a century, has been adopted by us and has been registered as our Trade Mark.

Fuller details and specification will be available shortly. Ask us to put your name on our mailing list.

THE AUTOMATIC COIL WINDER & ELECTRICAL EQUIPMENT CO., LTD.
WINDER HOUSE · DOUGLAS STREET · LONDON · S.W.1. Telephones: VICtoria 3404 (9 lines)

When it's a question of MINIMUM SIZES...

HUNTS METALLISED PAPER CAPACITORS

HUNTS METALLISED PAPER CAPACITORS
MIDGET MOLDSEAL TUBULARS
TYPE W99

Specification

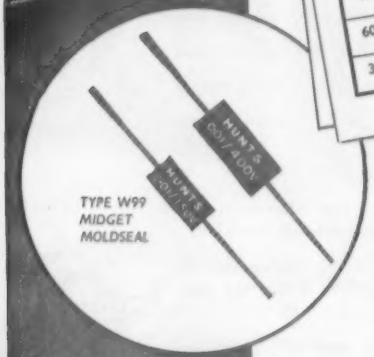
Heat moulded housing ensuring an adequate seal against moisture. Wire leads soldered directly to capacitor unit in a manner ensuring freedom from intermittent contact (strength of joint exceeds tensile strength of wire lead).

RANGES

Working Voltage	Temperature Range	Capacitance µF	Size
150 D.C.	—40°C to +71°C	0.004 to 0.01 0.02 to 0.04	A B
400 D.C.	—40°C to +85°C	0.001 to 0.003 0.004 to 0.01	A B
600 D.C.	—40°C to +85°C	50pf to 0.001 0.002 to 0.004	A B
300 A.C.	—40°C to +71°C	50pf to 0.001 0.002 to 0.004	A B

SIZES "A = 5/16" x 3/8" B = 1/2" x 5/8"

Capacitance Tolerance: Standard ± 20% (Closer tolerance available) Insulation Resistance: 20,000 megoh... working voltage... Power Factor ... than 2% at 1,0... per second at 20...



TYPE W99
MIDGET
MOLDSEAL

TYPE W97
MIDGET
THERMETIC
—100°C to +120°C

Look to HUNTS!

For maximum reliability. Hunts capacitors for radio and electronic equipment include many types designed to meet the need of designers for decreased dimensions.

Type W99 listed above is just one example taken from Hunts unparalleled range of capacitors for every purpose.

Years of specialisation in nothing but capacitor design and manufacture has enabled us to achieve and maintain that long-lasting reliability, and outstanding performance which characterises every Hunt product.

Please write for leaflet giving full details of types for all applications.

REGISTERED TRADE MARK
HUNTS
CAPACITORS
THE TRADE MARK OF RELIABILITY
Established 1921

A. H. HUNT (Capacitors) LTD., WANDSWORTH, LONDON, S.W.18 BATtersea 1083-7
and in Canada • HUNT CAPACITORS (Canada) LIMITED, AJAX, ONTARIO

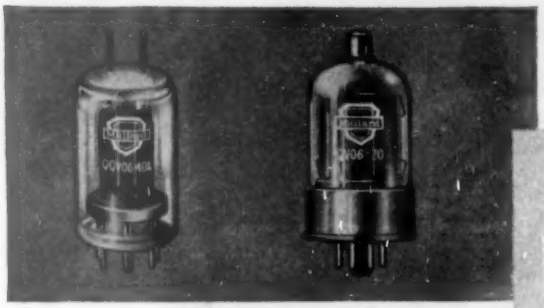
V.H.F. POWER TETRODES

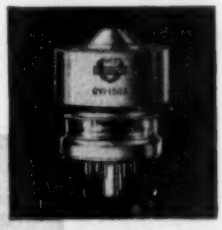
FOR F.M. & TELEVISION TRANSMITTERS

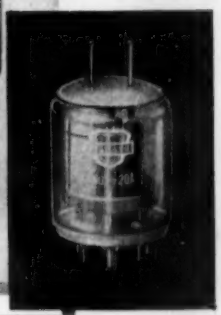
Transmitter designers are now offered a complete range of V.H.F. tetrodes by Mullard.

These high efficiency, high gain tetrodes make possible the design of transmitters with fewer valves and, consequently, reduced initial cost.

The higher overall efficiency of equipments fitted with Mullard tetrodes results in lower running expenses—a factor in the growing popularity of these valves in the world market. Further details of these tetrodes and other Mullard valves and tubes may be readily obtained from the address below.







PRINCIPAL CHARACTERISTICS

MULLARD TYPE No.	AMERICAN TYPE No.	CV TYPE No.	DESCRIPTION	BASE	HEATER (V)	HEATER (A)	V_a max. (V)	p_a max. (W)	TYPICAL LOAD POWERS AND FREQUENCIES (W)	(Mc/s)
QV06-20	6146	CV3523	V.H.F. Power Tetrode	Octal	6·3	1·25	600	20	42 20	60 175
QQV03-20A	6252	CV2799	V.H.F. Power double Tetrode	B7A	6·3 12·6	1·3 0·65	600	2x10	39 15	200 600
QQV06-40A	5894A	CV2797	V.H.F. Power double Tetrode	B7A	6·3 12·6	1·8 0·9	600	2x20	72 45	200 500
QY3-125	4-125A	CV2130	V.H.F. Power Tetrode	B5F	5·0	6·5	3000	125	300	120
QY4-250	4-250A	CV2131	V.H.F. Power Tetrode	B5F	5·0	14	4000	250	800	75
QV1-150A	4X-150A	CV2519	V.H.F. Power Tetrode	B8F	6·0	2·6	1250	150	156 112	165 500
QY5-3000A	6076	CV6076	V.H.F. Power Tetrode	Special 4-pin	6·3	32·5	5000	3000	3300 *3500	75 220

* 2 Valves in push-pull. Television service.

Mullard

MULLARD LTD., COMMUNICATIONS & INDUSTRIAL VALVE DEPT., CENTURY HOUSE, SHAFTESBURY AVENUE, LONDON, W.C.2

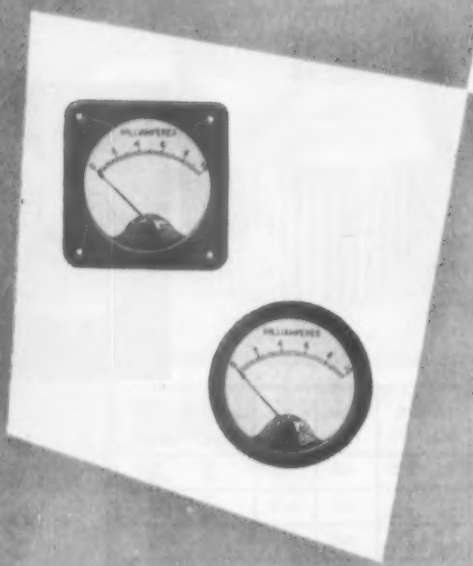
MVT.169

FERRANTI

CATHODE RAY TUBES

A wide range of Cathode Ray Tubes and Valves for industrial and domestic use is manufactured by the Electronics Department. 14" and 17" Rectangular Tetrode Cathode Ray Tubes with Aluminized screens and 6·3 volt, 0·3 amp. heaters are available.

Enquiries to Electronics Dept., Moston, Manchester, 10.



SMALL HERMETICALLY SEALED INSTRUMENTS

Ferranti 2", 2½" and 3½" Hermetically Sealed Instruments for Service requirements are available in both moving coil and moving iron types for current and voltage measurement.

Enquiries to Instrument Sales Dept., Moston, Manchester, 10.

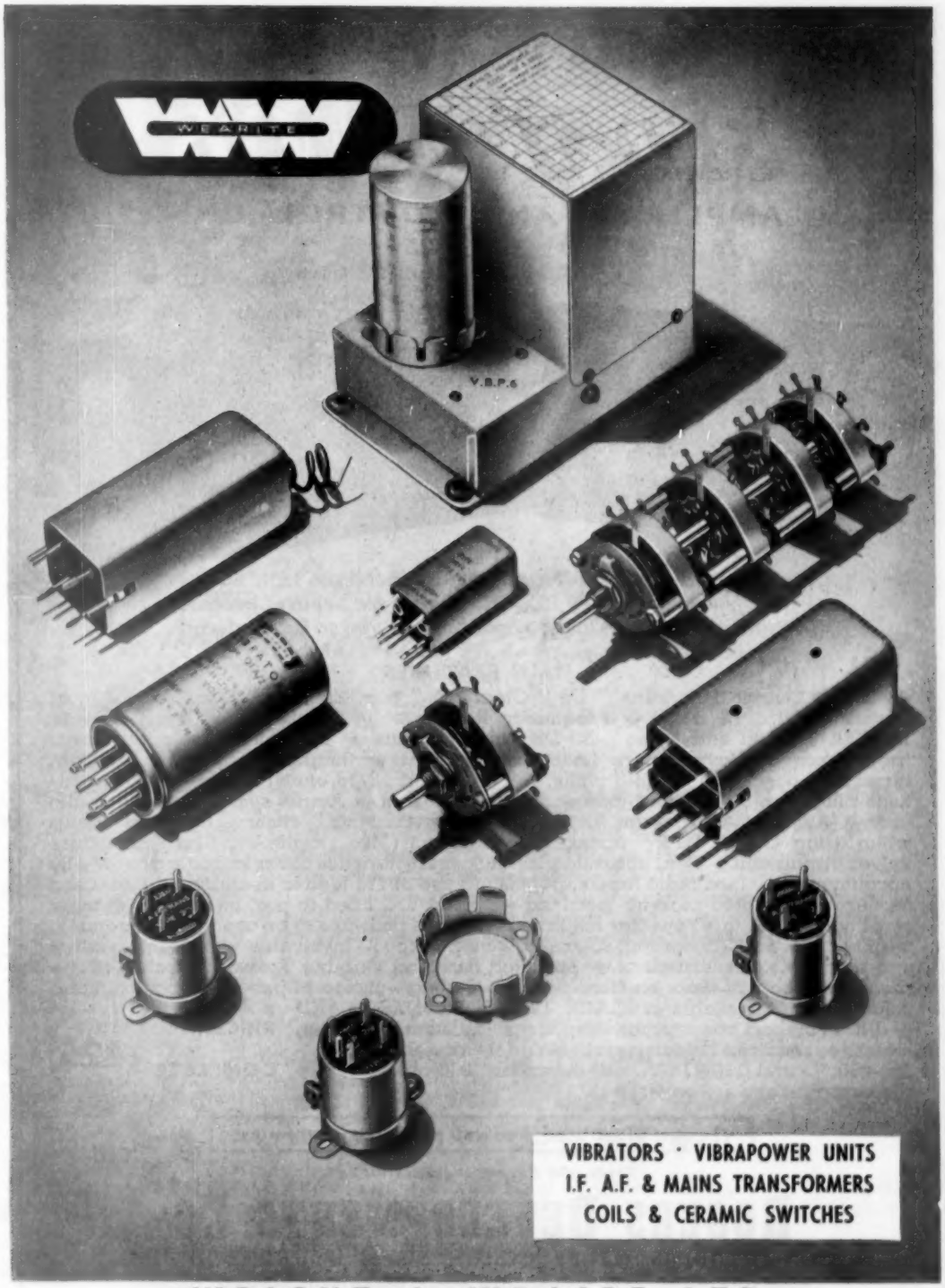
F FERRANTI

FERRANTI LTD · MOSTON · MANCHESTER 10

Head Office and Works: HOLLINWOOD · LANCS

London Office: KERN HOUSE, 36 KINGSWAY, W.C.2.

FG179



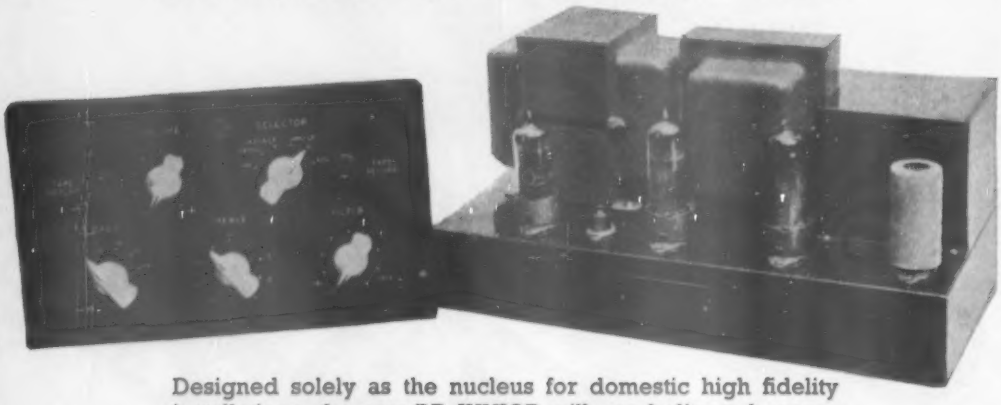
WRIGHT & WEAIRE LTD

131 SLOANE STREET · LONDON · SW1 · Telephone: SLOane 2214/5

INTRODUCING THE NEW

RD JUNIOR

AMPLIFIER AND CONTROL UNIT



Designed solely as the nucleus for domestic high fidelity installations, the new RD JUNIOR will, we believe, become recognised as the finest amplifier of its type so far produced in this country.

MAIN FEATURES

★ Power Output 8–10 watts ("UL" Class "A" p.p. EL84s) ★ Distortion .12% at 8 watts (.5% at 12 watts) ★ Frequency Response ± .25 DB 20–30,000 c.p.s. ★ 20 DB NFB ★ Hum and Noise −80 DB below 8 watts ★ Specially developed output transformer employs C-core lamination material ★ Simplified speaker matching, three impedance ranges (2–3 ohms, 6–8 ohms and 12–16 ohms) selected by "impedance plug," *no* connections to change, *no* soldering ★ Ample spare power for radio unit ★ A.C. outlet for gram. motor ★ "Presence Plug" ensures optimum results when using G.E.C. "FR" speaker ★ Compact (11in. × 6in. × 5¾in.), miniature valves throughout ★ Four accurate playback characteristics cover all records normally encountered ★ Two radio inputs, permitting use of FM feeder in addition to standard feeder ★ Simplified pick-up matching—pre-set V/C fitted to p.u. input ★ High input sensitivity (30–50 m/V) enables majority of modern pick-ups to be used ★ Independent variable low pass (distortion) filter (4.5 kc/s–8.5 kc/s)—invaluable with older records and poor radio transmissions ★ Switched Bass and variable Treble controls ★ Tape record and replay jacks on front panel ★ Styling—choice of panel and control knob colours, panel available in BLACK, IVORY, BRONZE or RED ★ Ultra compact construction simplifies installation, only 1½in. clearance required behind panel ★ Models available for 200–230–250 V. and 110–115–125 V. operation ★ Both units are semi-tropical and are covered by a TWO YEAR GUARANTEE.

PRICE COMPLETE **£25**

12-page Illustrated Booklet post free on request

Trade and Export enquiries invited.

ROGERS DEVELOPMENTS CO

MANUFACTURERS OF PRECISION BUILT SOUND EQUIPMENT

"RODEVCO HOUSE," 116, BLACKHEATH ROAD, GREENWICH, LONDON, S.E.10.

Telephone : TIDeway 1723. *Telegrams : RODEVCO, GREEN, LONDON*

PROFIT...

BY EXPERIENCE

Type numbers in the Mullard system of valve type nomenclature are a form of shorthand giving brief technical details of each valve type. For instance, the Mullard EF91 is a miniature R.F. pentode with a heater rating of 6.3V. This, of course, is vital information, which indicates the sort of function the valve will perform. It is primarily intended for use as a R.F. amplifier or mixer valve in television receivers.

But just as vital as knowing what a valve will do, is knowing how long it will do it efficiently. The name Mullard before the type number means that the valve is the result of Mullard advanced quantity production techniques and extremely stringent quality control—the secrets behind the remarkable dependability of Mullard MASTER Valves.

there is over 30 years' experience behind the Mullard EF91

PROFIT BY THE EXPERIENCE OF THIS SERVICE ENGINEER

Mr. J. Haskell of the Radio & Television Department of Messrs. Jordan's Garage, Ltd., Godalming, says:—

"It is not by mere chance that we use Mullard replacements. It is because our long experience in radio has proved that Mullard valves are consistently reliable and efficient—saving us time and trouble and ensuring the continued satisfaction of our customers."

Mullard

THE MASTER VALVE

PADIHAM BLACKBURN WANDSWORTH MITCHAM LYTHAM ST ANNES
WHYTELEAFE FLEETWOOD GILLINGHAM HOVE WADDON RAWTENSTALL

MULLARD LTD., CENTURY HOUSE, SHAFTESBURY AVENUE, LONDON, W.C.2

MVM 2858

The performance of only as good as

Multiway Plugs and Sockets for quick action and positive contact

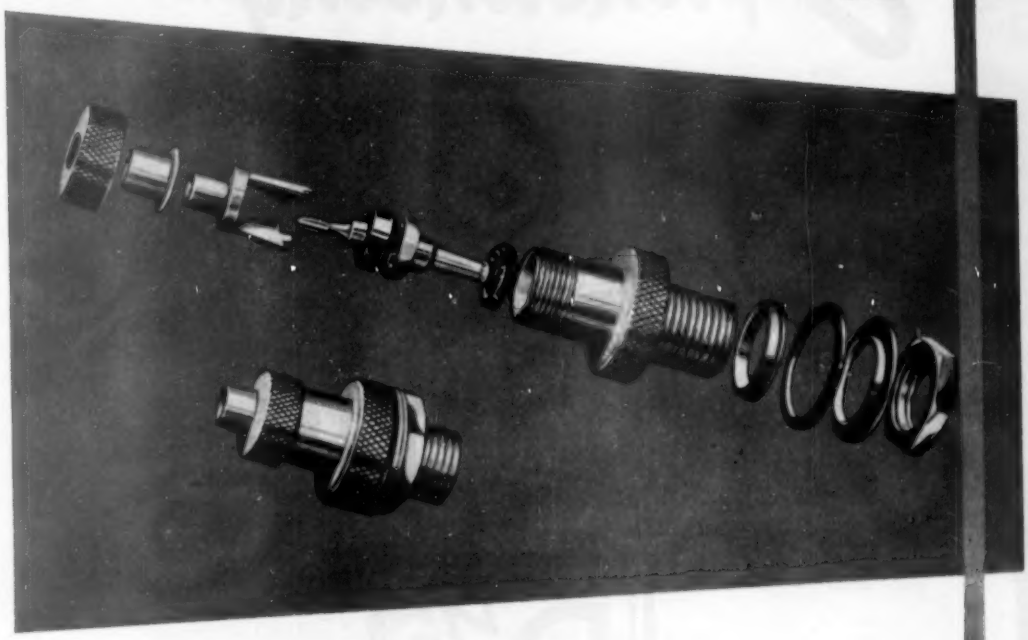
These reliable Plugs and Sockets, proved in service, provide a quick positive connection for up to 28 terminations. They need lower insertion pressure per contact than any comparable product, and when fully mated a dust and damp proof seal is provided between Plug and Socket. Considerable latitude in matching can be allowed when they are used in rack mounting applications.

These components are in regular use by :— The English Electric Co. Ltd., Messrs. Marconi's Wireless Telegraph Co. Ltd. and Messrs. Standard Telephones & Cables Ltd.

4 WAY 8 WAY 12 WAY 20 WAY 28 WAY

PLEASE WRITE FOR FURTHER DETAILS TO

any equipment is its terminals



These versatile Miniature connectors provide perfect coupling between co-axial cables and instruments, and are extensively used in Television, Radar, and Communications equipment. They are 100% pressure and flash tested before despatch. The full range consists of a variety of Cable and Panel Mounting units of either plug or socket type, and a recent addition is an elbow connector for applications where it is desired to keep the face of the panel clear. Suitable for use with co-axial cable Uniradio 32 and 43.

Miniature hermetically sealed Co-axial Plugs and Sockets to RCS.322

A.I.D & A.R.B — APPROVED

POWER CONTROLS
LIMITED

EXNING ROAD, NEWMARKET. TELEPHONE NEWMARKET 3181

Announcing–

PHOTO PRINTED CIRCUITS

Entirely new, fully proved techniques now available to the trade

PATENTED AND PATENTS PENDING

These advanced techniques of photo-printing electronic circuits and components were demonstrated with outstanding success at the recent FARNBOROUGH AIR DISPLAY and at the 1954 RADIO SHOW.

They are now fully available for use by the Trade.

A complete departure from conventional methods, the new techniques are fully covered by patents and patent applications under which the Proprietors are prepared to grant licences on reasonable terms.

Complete freedom to use new process

Following an exhaustive search into existing patents, legal experts have advised that these techniques are entirely new and may be used with complete freedom by the Proprietors and their licensees.

PHOTO PRINTED CIRCUITS

Enquiries regarding manufacture and licences should be made to:

NORTON & GREGORY LTD

GUILDFORD ROAD · BISLEY · SURREY

Telephone: BROOKWOOD 2200

THE NEW E·M·I 25 Mc/s OSCILLOSCOPE

For Research, Design, Production Testing and Servicing.

A new all-purpose wide range precision measuring oscilloscope based on a simple, economic and well tried design.

The WM.5. which is console (or 19" rack) mounted, has provision for six additional sub-units which can be used individually or suitably combined to extend the performance of the oscilloscope to meet almost any requirement within the fields of:—High definition radar, Nucleonic investigation, Electronic computing, Television studio and transmitter equipment, H.V. Pulse test and general electronic measurement.

BASIC OSCILLOSCOPE—SPECIFICATION.

EMITRON CRT. TYPE 4EP1. Post Deflect Accel. 10KV max.
Diameter 10 cms. Side arm plate connections.
Sensitivity — X Plates. 0.1 mm/V — 1.0 mm/V (A_2 5KV — 0.5 KV).
Y Plates. 0.174 mm/V — 1.74 mm/V (A_2 5KV — 0.5 KV).

TIME MEASUREMENT
100 milli-seconds — 10 milli-micro-seconds (±2½%) in 11 ranges.

VOLTAGE MEASUREMENT
500V — 100 mV (±2½%) in 7 ranges.
Extended to 10mV with suitable sub units.

VOLTAGE REFERENCE
Voltages can be measured relative to external circuit potentials up to ± 500 volts.

SWEEP SPEED RANGE
150 cms/microseconds (5×10^{-9} sec/cm) to 33 cms/sec. (3×10^{-3} sec/cm).

Z INPUT
10Vpp for beam cut off (brightness control normal).
Cathode modulation frequencies up to 100 Mc/s.

RATE PULSE OUTPUT
10Vpp repetition as time base (100 Kc/s — ½ c/s).
Rise time 0.15 microseconds.

SAWTOOTH OUTPUT
100Vpp repetition as time base (100 Kc/s — ½ c/s).

PHOTO SWEEP
Single sweep for photo recording of transients, subsequent few sweeps before blackout of tube give reference trace which can be preset to any voltage up to ± 500V D.C.

SWEEP DRIVE
Min of 0.1Vpp to trigger time base.

SWEEP & DRIVE CIRCUIT FEATURES
(*a*) Phase Selector—Ultimate trigger or sync potential selected from a positive or negative wavefront.
(*b*) Time Base—Recurrent or Triggered and delayed/undelayed.
(*c*) Delay period/sweep period ratio—
240 max. 1 min. (shortest time range).
24 max. 1 min. (longest time range).

DUAL INPUT AMPLIFIERS	BANDWIDTH	* SENSITIVITY (EHT.10KV)	* SENSITIVITY (EHT.1KV)
X { Gain X3	D.C.— 8 Mc/s.	0.33 mm/V.	3.3 mm/V.
X { Gain X17	D.C.— 6.5 Mc/s.	2 mm/v.	20 mm/V.
Y { Gain X6	D.C.—25 Mc/s.	1 mm/V.	10 mm/V.
Y { Gain X12	D.C.— 9 Mc/s.	2 mm/V.	20 mm/V.

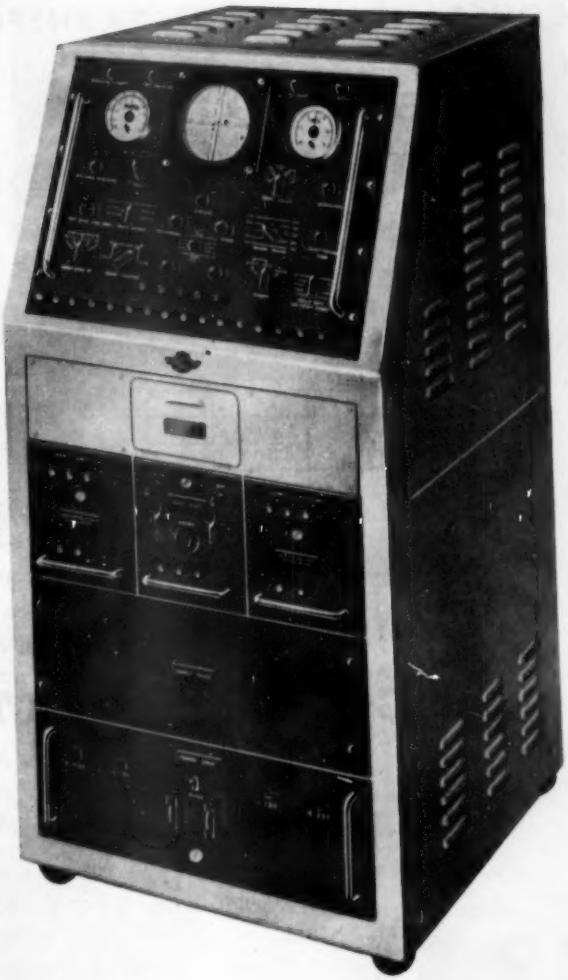
* Extended to 500mm/V with suitable sub unit.

E. M. I. FACTORIES LTD.

Head Office: HAYES, MIDDLESEX Telephone: SOUTHALL 2468

Telegrams & Cables: EMIFACTORY, LONDON

TYPE WM.5.



NEW FEATURES

1. New CRT—CONTINUOUSLY VARIABLE EHT. 1-10KV.
   Gives deflection sensitivity ratio control from 1 to 10 with unaltered frequency response.
   Enables selection of optimum operating condition for definition/writing speed/repetition rate and deflection sensitivity.

2. Y AMPLIFIER D.C.—25 Mc/s. (No Overshoot.)
   Differential input channels for signal time comparison and mixing.

3. LINEAR PRE-SWEEP SIGNAL COMPRESSION.
   Provides a linear pre-sweep vertically displaced from the normal sweep. Pre-sweep (duration 1 sec. —10 microseconds) can be varied from 1 to 240 times the normal sweep duration. Any series of complex waveforms can be displayed in compressed form on the pre-sweep and from this any small section can be identified and transferred to the normal sweep for display and measurement in expanded form.

4. DELAYED SWEEP:—
   Sweep may be delayed with respect to input trigger by 10 microseconds—1 sec. (in accordance with time range).

5. INSTANTANEOUS AC/DC VOLTAGE MEASUREMENT. (No calibration markers required.)
   Null indication C.R.T. Long scale voltmeter readings unaffected by amplifier or CRT non-linearity.

6. INSTANTANEOUS TIME MEASUREMENT. (No calibration markers required.)
   High accuracy time readings are meter presented.

WM.5. SUB UNITS.

INPUT UNIT TYPE 1—A special coupling unit for X,Y,Z, or sweep drive channels of the WM.5. High input impedance via cathode follower probe. 0.5 microseconds signal delay. Bandwidth - 40 Mc/s.

PRE-AMPLIFIER TYPE 3.
Bandwidth - 40 Mc/s. Gain x 10.
Input and Output Impedances - 300 ohms.

OTHER E·M·I EQUIPMENT

OSCILLOSCOPE TYPE WM.1.

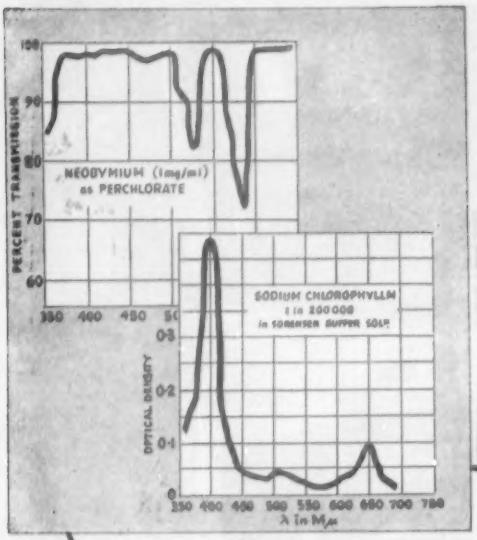
An inexpensive general purpose oscilloscope, incorporating the E.M.I. valve voltmeter measurement system. Voltage Measurement: ± 0.5 - ± 500 volts AC/DC. Instantaneous reading.

OSCILLOSCOPE TYPE WM.3B.
A compact general purpose portable oscilloscope with facilities for rapid precision time and voltage measurements.
Voltage measurements by instantaneous metering system } (± 10 mV - ± 500V. AC/DC.)
No calibration markers required. This instrument can be supplied with trolley.

OSCILLOSCOPE TYPE 3794.TA.
A trolley mounted multi-purpose precision measuring oscilloscope CRT, EHT-5kV.
Voltage measurements by instantaneous metering system. } (± 50 mV to ± 500V. AC/DC.)

DISTRIBUTED AMPLIFIER TYPE 2B.
A unit designed for use with high speed oscilloscopes to provide amplification over a very wide frequency spectrum (50 c/s—100 Mc/s) at high output voltage levels.

CONSTANT VOLTAGE TRANSFORMERS IN **RESEARCH**



Percentage Concentration....?

CONSTANT VOLTAGE *required!*

The Physicist tells us that with an electrical light source:

Intensity ∝ (Volts)⁴

Hence in all photometric devices as used in spectroscopic analysis, it is essential that a reliable stabilized voltage supply is available. The research chemist turns to "Advance" Constant Voltage Transformers to fulfil this need for which they are so admirably suited.

Full details given in folder W115, gladly sent on request.

The illustration of spectrophotometer by courtesy of Unicam Instruments

Advance
CONSTANT VOLTAGE TRANSFORMERS

CVT

ADVANCE COMPONENTS LIMITED
MARLOWE ROAD, WALTHAMSTOW, LONDON, E.17.
Telephone: LARkswood 4366

GD.

Mr. Hardy, Hudson's Chief Engineer, hands over to the Chairman of the Horten taxi-owners association the fleet of taxis fitted with Hudson radio-telephone equipment, 13th September, 1954.

Hudson

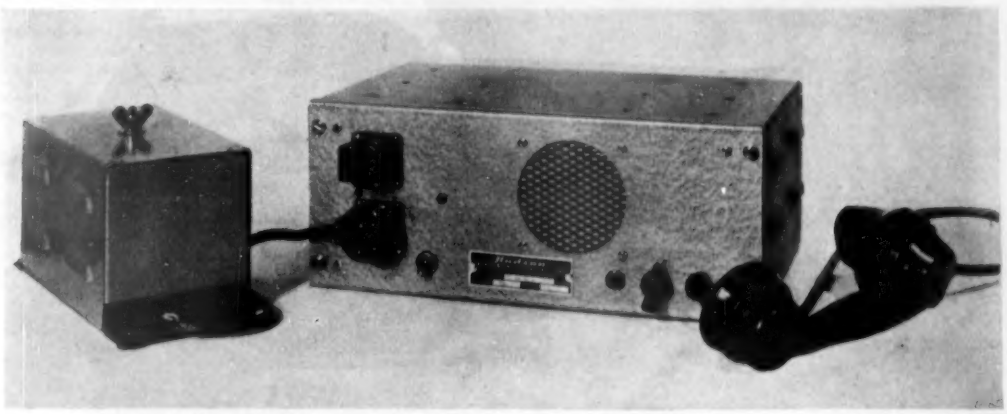
OF LONDON

install

THE LARGEST

TAXI R.T. SYSTEM IN NORWAY

SINCE Horten, sixty miles from Oslo, is the first town in Norway to have radio-telephony installed in an entire fleet of taxis, it is natural that the event aroused considerable interest and was reported at length in the Horten press, whose reporters participated in an extensive trial run and test. Our Chief Engineer flew to Horten to supervise the setting up of the fixed station and the equipping of the taxis. Thus, Norway has become yet another overseas country to use British made Hudson radio-telephone equipment.



Model AM/150/M, the transmitter and receiver unit fitted to Horten taxis. Combines high performance and economical battery consumption with low maintenance cost. For use in cars, commercial vehicles and ships.

LIST OF MODELS

AM/250/M, 5-watt Vehicle Station, 60 to 100 Mc/s.
AM/250/M MK.2, as above, but with P.A.
AM/150/M, 5-watt Vehicle Station, 100 to 185 Mc/s.
AM/250/F, 6-watt Fixed Station, 60 to 100 Mc/s.
AM/150/F, 5-watt Fixed Station, 100 to 185 Mc/s.
AM/150/F/10C, 10-Channel AM Marine Radio Telephone.
HED.102, Walkie-Talkie, 60 to 132 Mc/s.
FM.101, 10-watt FM Fixed Station, 60 to 185 Mc/s.
FM.101/10C, 10-Channel FM Marine Radio Telephone.
FM.102/4C, 10-watt, 4-Channel FM Vehicle Station, 60 to 185 Mc/s.
HED.113, 50-watt Fixed Station, AM or FM, 60 to 185 Mc/s.

Supplied to the G.P.O. and Home Office.

HUDSON ELECTRONIC DEVICES LTD.

APPACH ROAD, LONDON, S.W.2 TEL. TULSE HILL 4861

"Frequentite" is the most suitable insulating material for all high frequency applications. Seventeen years ago we introduced the first British-made low-loss ceramic, and consultation with us before finalising the design of new components is a wise precaution.

STEATITE & PORCELAIN PRODUCTS LTD.

Head Office: Stourport-on-Severn, Worcestershire. Telephone: Stourport 111. Telegrams: Steatain, Stourport

S.P.77

LOCKWOOD

Standard Loudspeaker Cabinet

This new 'LOCKWOOD' model has been manufactured to meet the demand for a cabinet of high quality, and in conjunction with various loudspeaker units and high fidelity apparatus is capable of giving reproduction of a very high order.

*A vented design developed from the Monitoring Loudspeaker Cabinet used by The British Broadcasting Corporation (BBC. PAT. 696,671), this enclosure is, we believe, the sensible approach to the problem of providing good quality in the home at a reasonable price.

The combination of good materials and first class workmanship is incorporated in a functional design, and this cabinet is acceptable in most furnishing schemes. It can be manufactured in exotic veneers additional to the almost traditional Oak, Mahogany or Walnut, or alternatively in coloured finishes, suitable for Broadcasting and Television Studios. **£35**

A brochure, free on request, fully explains this new model and why it is supplied ready to assemble.

EXPORT & TROPICAL MODELS AVAILABLE.

Trade enquiries invited.

DEMONSTRATIONS BY APPOINTMENT ONLY.

LOCKWOOD

Acoustically Designed Cabinets

* *"Wireless World," November & December, 1950.*

LOCKWOOD & Co · LOWLANDS ROAD · HARROW · MIDDLESEX

Time, money, tempers -all lost if you prepare a portable radio design and then find you haven't left room for the battery. Naturally, Ever Ready can supply special units, but it's so much simpler to call us in early so that your set is designed, if possible, to take one of our many standard batteries.

EVER READY
REGD. TRADE MARK

DRY BATTERIES FOR RADIOS

✳ *If you have a design problem involving dry batteries, get in touch with us at Hercules Place, Holloway, London, N.7 Telephone: ARChway 3030.*

The

W.90a

DUAL BAND

Standard Television

SIGNAL GENERATOR

The synchronising waveform is strictly in accordance with British Television Standards.

A complete television signal source intended for development, production and service departments. A comprehensive series of test patterns is provided, allowing complete determination of receiver performance. Sound and vision signals at adjustable relative levels are available over both television Bands I and III. The two signals may be used, simultaneously or independently, and a calibrated output attenuator is fitted. Provision is made for internal or external modulation of sound carrier. The generator is rated for continuous operation, and a high degree of stability has been achieved. **Price £180 nett.**

TECHNICAL SPECIFICATION

R.F. OUTPUT: Sound and vision carriers are independently adjustable for frequency throughout each band.
FREQUENCY RANGE: (Vision and Sound):
Band I: 40 to 70 Mc/s. continuously variable.
Band III: 170 to 220 Mc/s. continuously variable, **CALIBRATION ACCURACY** ±0.5%
LEVEL: (peak white vision): 1 μV to 100 mV pp.
(sound) 1 μV to 100 mV r.m.s.
Regulated by independent R.F. controls and calibrated meter, in conjunction with multiplier of 20 db steps. A higher output of approximately 500 mV is available for multi-distribution.
OUTPUT IMPEDANCE: 75 ohms unbalanced.
SOUND MODULATION: 0-30% at 1,000 c.p.s. sinusoidal.
The sound generator can also provide unmodulated C.W. or may be externally modulated from a radio receiver or pick-up, etc.
VIDEO MODULATION: The video modulation is in accordance with the B.B.C. standards and includes horizontal and vertical blanking pulses and the correct synchronising pulses. The ratio of sync to modulation is carefully maintained, and the half line frame pulses and the front and back porches of the line pulses are included.
The following patterns may be obtained via switches on the front panel:—

1. Blank black raster for sync separator checking.
2. Blank white raster for interlace checks and hum or breakthrough checking.
3. Line modulated with ½ μS pulses, rise time 0.1 μS approximately, for checking line linearity. V.F. response, "ringing," etc. The vertical rulings produced are variable in number from 1 to about 40 per line.
4. Line modulated at 2 Mc/s, 2.5 Mc/s, and 3 Mc/s. for checking receiver bandwidth and definition. The definition lines are accompanied by marker lines at predetermined intervals to facilitate observation of displayed response.
5. A centre black bar can be inserted for checking linearity by the two halves method
6. Frame modulated with a graded step waveform for contrast and V.F. stage. checking (Gamma).
7. Frame modulated with wide black bars for checking L.F. response.
8. Frame modulated with thin lines for checking frame linearity.

Any of the line and frame patterns may be combined to produce a complex pattern; for example, patterns 3 and 8 provide a crosshatch pattern suitable for observing "pin-cushion" and "barrel" distortion and the combined effect of non-linearity of line and frame.
VIDEO OUTPUT: The complete video waveform is available for V.F. checks and the complete sync waveform is brought out separately. Line and frame blanking pulses are also brought out separately for use with flying spot scanners or monoscope tubes. The video output is 5 v. pp. at 166 ohms positive or negative. An alternative model is available with a single positive output of 1 v. pp. at 75 ohms.
GENERAL: The master frequency is adjustable and may be locked to the mains or unlocked for hum checks. Independent amplitude and frequency control of the sound and vision carriers facilitates observation of Sound-on-Vision or Vision-on-Sound interference. The generator is rated for continuous operation. The oscillator sections are carefully filtered and well shielded and the external stray fields are negligible. The instrument with self-contained power supply is contained in a black crackle-finished steel case with carrying handles. The case may be removed where it is desired to mount the generator in a rack.
POWER SUPPLY: 200/250 volts, 50 cycles, A.C. Mains.
SIZE: 17in. long x 9in. high x 10in. deep.

A waveforms PRODUCT

WAVEFORMS LTD., RADAR WORKS, TRURO ROAD, LONDON, N.22 **Telephone: Bowes Park 6641/2/3**

7 Sound Reasons for choosing MSS Direct Recording Disks

NEGLIGIBLE BACKGROUND NOISE

M.S.S. disks permit of a dynamic range greater than 60 db. at 78 r.p.m. (max. stylus vel. 8 cm/sec., r.m.s.) and greater than 54 db. at 33 r.p.m.

WIDE FREQUENCY RESPONSE

The quality of the equipment used is the only likely limitation of the recording range of M.S.S. disks.

CLEAN SWARF THROW

The anti-static properties of M.S.S. disks ensure that with a correctly designed cutter the swarf is thrown towards the centre of the disk in a manner allowing of easy removal.

HIGH RESISTANCE TO WEAR

The groove walls of all M.S.S. disks will stand up to constant playback without diminishing the level of the higher frequencies.

SUITABILITY FOR PROCESSING

M.S.S. disks fulfil all processing needs; a special feature is the absence of the 'horn' or 'hangnail' at the groove edges even at high stylus velocities — a valuable advantage in microgroove recording.

RESISTANCE TO AGEING AND CLIMATE

M.S.S disks can be stored, blank or recorded, for indefinite periods under extremes of climate without loss of quality or performance.

FOUR GRADES SAVE YOU COST

A grading system based on selection enables you to choose the right priced disk for the job. For example, top grade disks must be beyond reproach in appearance as well as performance, and are, therefore, selected to conform to extra stringent standards of quality.

Contractors to
The Admiralty
General Post Office
Ministry of Supply
British Broadcasting Corporation

You can be certain of a perfect recording with M.S.S. disks. That is why so many leading recording and broadcasting companies throughout the world always use them. Let us send you further information on the four grades of M.S.S. disks available.

THE MASTER SOUND SYSTEM

M.S.S. RECORDING COMPANY LIMITED
POYLE CLOSE, COLNBROOK, BUCKS, ENGLAND. Phone: COLNBROOK 284
Manufacturers of Sound Recording Equipment

The Invisible link with the Isolated Community

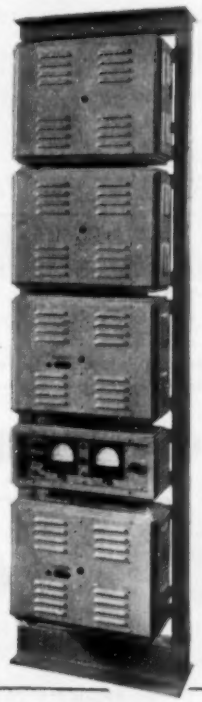
V.H.F.

RADIO TELEPHONE

Subscriber pole-mounted battery operated unit

- ★ **No Change in Normal Telephone Operating Procedure**
- ★ **Mains or Battery Operation**
- ★ **Signalling Units for All Types of Circuit**

The V.H.F. link provides the most practical means of direct communication between isolated communities in all areas where the nature of the terrain or distance involved preclude the use of open wires for junction or subscribers' lines. Dialling facilities can be employed, and the radio equipment can be interposed in a standard line circuit in any part of a telephone system without modification to switching equipment.



Exchange equipment bay

AUTOMATIC TELEPHONE & ELECTRIC CO. LTD.

Radio & Transmission Division, Strowger House, Arundel Street, London, W.C.2. 'Phone: TEMple Bar 9262. 'Grams: Strowgerex London.

AT14511-Bx107

This low frequency oscillator costs only £75

(Bench stands 1 gn. extra)

This reasonably-priced low frequency oscillator is extensively used in the aircraft industry and elsewhere as a convenient source of signals down to 1.15 c.p.s. for the testing and calibration of vibration recorders, servo systems etc. It is also widely used in medical research and clinical work for the calibration of biological amplifiers and recorders, and low frequency wave analysers.

Brief Specification:				
TYPE	FREQUENCY RANGE	OUTPUT	INPUT	CONSTRUCTION
Resistance capacity, with automatic amplitude control effective over the whole frequency range.	1.15 c.p.s. to 5,500 c.p.s.	Sine wave 50 volts peak to peak push-pull, with built-in attenuator.	200-250 volts, 40-60 c.p.s.	Standard 19" rack mounting, but also suitable for bench use. Bench stands available.
NOTES. An incremental switch is fitted. Provision is made for mixing other signals with the output.				

Immediate delivery from

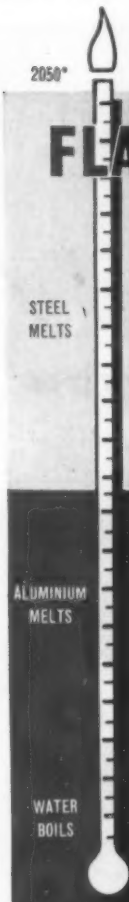
EDISWAN

RADIO DIVISION · THE EDISON SWAN ELECTRIC COMPANY LIMITED

Member of the A.E.I. Group of Companies

155 Charing Cross Road, London, W.C.2. *Telephone:* Gerrard 8660. *Telegrams:* Ediswan, Wescent, London

SP 150



FLAME POLISHING AT 2050°C

makes WINDSOR the most sought-after sapphire stylus

At last—the first scratch-free cone is now available! There can be no harmful substance embedded in a WINDSOR sapphire stylus, to scratch and damage precious records.

Why? Because the WINDSOR method of polishing is to turn each point in flame, at 2050°C. This temperature makes steel look like orange juice; its effect on sapphire is to double its tensile strength. A de-stressed, re-crystallized sapphire is produced. The point, which is rounded to perfection, is completely free from abrasive substances.

Holdered in all the usual **WINDSOR** family range:

Midget

Straight

Trailer

Cantilever —for use in the B.S.R. MONARCH.

We call this stylus the WINDSOR FLAME-FASHIONED SUPER SAPPHIRE. *Super* because it's the hardest, smoothest, most durable ever made.

ONLY 5/6 EACH

inc. tax, from all retailers.

WINDSOR

FLAME-FASHIONED SUPER SAPPHIRE

Made exclusively by

SAPPHIRE BEARINGS LTD., 96a MOUNT ST., LONDON, W.1

Easily the world's largest makers of Sapphire Styli

60 WATT H.F. FIXED STATION

This completely new Pye equipment has been specifically designed for point-to-point communication and will fulfil equally well a ground-to-air role in air traffic control systems.

Push button control brings any one of four preselected channels into immediate operation; this facility is also available when the equipment is installed for remote unattended operation. The 60 watt Fixed Station Transmitter offers R/T, C/W, or M.C.W. operation with 'break-in' facilities on telegraphy.

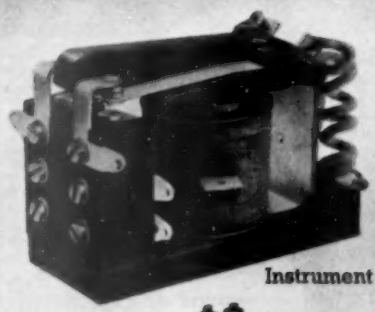
The equipment is suitable for unattended operation in the tropics.

Telecommunications

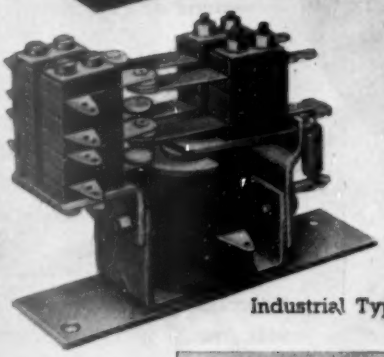
CAMBRIDGE ENGLAND

Pye (New Zealand), Ltd., Auckland C.I., New Zealand.	Pye Canada, Ltd., Ajax, Canada.	Pye-Electronic Pty., Ltd., Melbourne, Australia.	Pye Ireland, Ltd., Dublin, Eire.
Pye Radio & Television (Pty.) Ltd., Johannesburg, South Africa.	Pye Limited, Plaza de Necaxa 7, Mexico 5.	Pye Limited, Tucuman 829, Buenos Aires.	Pye Limited, 5th Avenue, Bdg., 200 5th Avenue, New York.

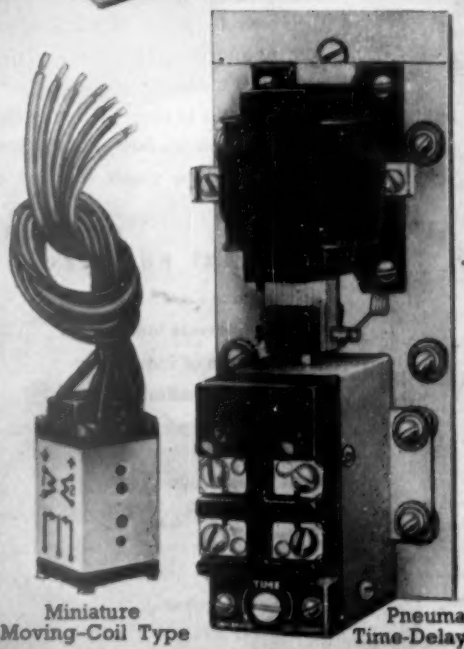
PYE LIMITED • • CAMBRIDGE • • ENGLAND



Instrument Type



Industrial Type



Miniature Moving-Coil Type

Pneumatic Time-Delay Type

Also manufacturers of:- **Cartridge Thermostats, Adjustable Contact Thermometers, Magnetic Amplifiers, Low-Inertia Integrating Motors.**

ELECTRO METHODS LTD OF STEVENAGE

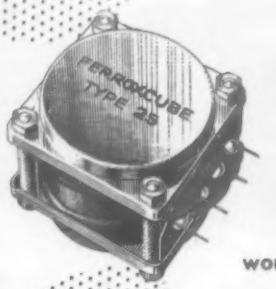
—the first name for precision

RELAYS

Comprehensive technical data of our extensive range of standard relays will be forwarded on request

Most types now available for PROMPT DELIVERY

ELECTRO METHODS LTD. (Division WR), CAXTON WAY, STEVENAGE, HERTS
PHONE: STEVENAGE 780



High Q inductance coils

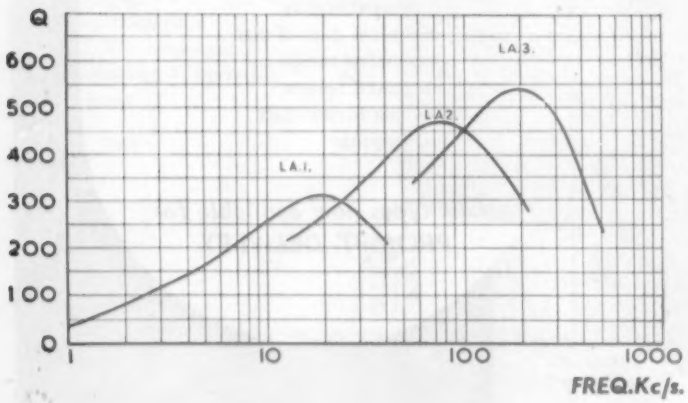
wound on Ferroxcube cores

DESIGNERS of compact and efficient tuned circuits and wave filters are making ever-increasing use of Mullard high Q inductance coils.

Based on Ferroxcube, the world's most advanced magnetic core material, these coils combine small size with an inductance of up to 30 henries over a wide frequency range. Furthermore, their convenient shape and self screening properties facilitate either individual mounting or stacking.

Full details of these and other high grade components now available from Mullard will be gladly supplied on request.

TYPICAL Q VALUES



Special Features

- **Small size**
- **Low hysteresis loss factor**
- **High value of inductance**
- **Low self capacitance**
- **Controllable air gap facilitating inductance adjustment**
- **Self screening**
- **Controlled temperature coefficient**
- **Operation over a wide frequency range**
- **Easily mounted**

Mullard

'Ticonal' permanent magnets,
'Magnadur' ceramic magnets,
Ferroxcube magnetic cores.

MULLARD LIMITED · COMPONENT DIVISION · CENTURY HOUSE · SHAFTESBURY AVENUE · LONDON · W.C.2
(MM450)

Stand-off Insulator

X-Ray Tube Shield Window

Cast in ARALDITE

For moulding, potting or sealing purposes, no resin can compare with 'Araldite'. Added to remarkable electrical and mechanical qualities, it offers outstanding adhesion to metals, while shrinkage in setting is exceptionally low. 'Araldite' resists high temperatures, humidity and corrosive agents and fulfils the Services specification for sealing and potting electrical equipment.

Our illustrations are of three components from Pantak Ltd., Slough, makers of X-ray equipment. Such mouldings must combine high mechanical strength with the capacity to withstand high voltages. They exemplify the versatility of 'Araldite' epoxy resins.

Cable Socket casting incorporating brass insert

These are the new Epoxies!

'Araldite' (regd.) epoxy resins are obtainable in the following forms:—

- *Hot and cold setting adhesives for metals and most other materials in common use.*
- *Casting Resins for the electrical, mechanical and chemical engineering industries.*
- *Surface Coating Resins for the paint industry and for the protection of metal surfaces.*

Full details will be sent gladly on request.

Araldite *epoxy casting resins*

Aero Research Limited

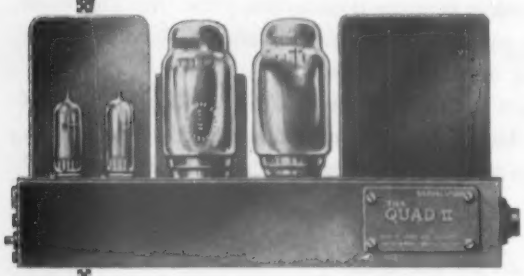
DUXFORD, CAMBRIDGE. Telephone: Sawston 187. A Ciba Company.

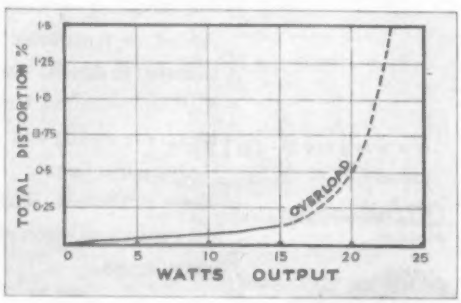
364/88

There are those who consider that there is little to choose in the range of power amplifiers now available—perhaps because the power amplifier is usually considered the "easy" part in the search for audio perfection. Why is it then that leading engineers are so enthusiastic about the QUAD II design?

. . . on feedback and linearity

They like the unique integrated feedback to provide complete stability independent of phase changes in the load current . . . the method used for eliminating the loop gain outside the audio range without prejudice to the input signal . . . the way that feedback is again used to provide optimum design stage by stage and to control the effective time constants. They like its use yet again to provide a unique self-balancing phase changer without the usual assymetry to the H.T. line. They like, too, the fact that the specification is fully met with commercially tested valves without matching or alignment of any kind. They extol the conservative ratings and restoration from overload (several nation-wide broadcasting corporations officially uprate the output to 20 watts, since with this degree of overload, distortion is still well within their acceptance figures).





Linearity and overload of the QUAD II amplifier

Good engineering for the best performance* also results in greater efficiency. Compare the size of the QUAD with any other amplifier of approaching specification. Note the size of the output transformer which results from optimum choice of flux and core material to suit design requirements.

The QUAD II power amplifier is primarily designed as part of the complete QUAD II amplifier. The power amplifier is also supplied separately as a quality standard when with a suitable input transformer it can be fed direct from a 600 ohm line.

* The unique output stage design principles are discussed in *Wireless World*, September, 1952.

The QUAD II is available throughout the world. Fully stocked servicing organisations are now operating in Canada, throughout U.S.A., Panama, Canal Zone Trinidad, Jamaica, Venezuela, Australia, Malaya, Singapore, Japan, Hong Kong, Burma, India, Ceylon, Pakistan, South Africa, Portugal, Italy France Switzerland, Belgium, Norway and Sweden.

ACOUSTICAL MANUFACTURING CO LTD

ACOUSTICAL MANUFACTURING CO. LTD., HUNTINGDON, ENGLAND

COSSOR

AIRFIELD SURVEILLANCE RADAR (ACR MK. VI)

now installed at LONDON, ZURICH and on Royal Dutch Airforce aerodromes

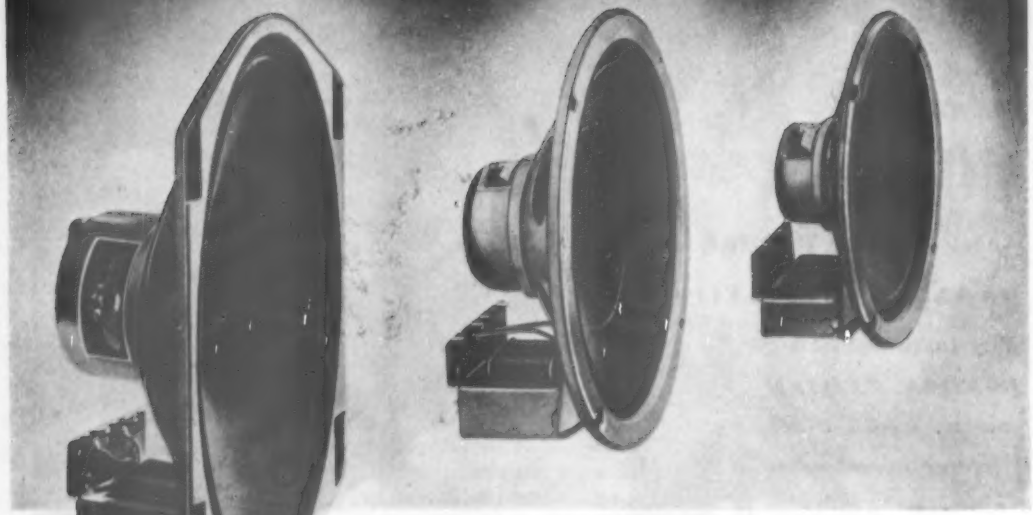
- ***PERMANENT ECHO CANCELLATION***
- ***C.R.D.F SUPERIMPOSITION***
- ***60 MILES RANGE***
- ***VIDEO MAPPING***

THE COSSOR GROUP OF COMPANIES · HIGHBURY GROVE · LONDON · N.5

A. C. COSSOR LTD · STERLING CABLE CO., LTD · COSSOR RADAR LTD

BEST PRODUCTS LTD · COSSOR (CANADA) LTD · BEAM INSTRUMENTS INC., (U.S.A.)

ELAC closed field...



...LOUDSPEAKERS

These loudspeakers have been designed to provide minimum magnetic interference together with high acoustic efficiency. ELAC Elliptical and round loudspeakers are used in most of the leading Television and Radio receivers.

PRICES INCLUDING P.T. FOR LOUDSPEAKERS LESS TRANSFORMER AS FROM NOV. 1st. 1954.

7" × 4" Elliptical	Flux 6,500 Gauss	21/10	6½" PM. 6G	Flux 6,500 Gauss	21/10
3½" PM. 3G	Flux 6,500 Gauss	19/10	8" PM. 8D	Flux 7,500 Gauss	29/1
5" PM. 5G	Flux 6,500 Gauss	20/6	10" PM. 10D	Flux 7,500 Gauss	34/4

ELAC

ELECTRO ACOUSTIC INDUSTRIES LTD.

Stamford Works, Broad Lane, Tottenham, N.15

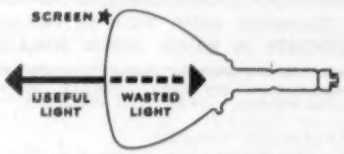
This ALUMINIZED Picture tube gives

60% brighter pictures
more contrast
extra tube life

AN Ediswan Mazda aluminized picture tube gives a picture 60% brighter and more contrasty than is possible with an ordinary tube.

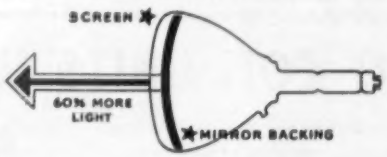
In addition, Ediswan aluminizing protects the screen from ion burn and, with the new Ediswan ion trap tetrode gun to protect the cathode, tube life is increased.

Ediswan production methods, which include the special in-line vacuumizing system, ensure a higher, more uniform standard of lasting efficiency. For complete satisfaction demonstrate and recommend Ediswan Mazda aluminized picture tubes.



WITHOUT ALUMINIZING

Without aluminizing, tubes waste half their light (see diagram above). To counteract this the brilliance must be increased and the tube life is shortened.



WITH EDISWAN ALUMINIZING

Ediswan aluminized tubes have a mirror backing to the screen. All the light is thus thrown forwards giving brighter, clearer pictures and extra life.

RV9

NATION WIDE SERVICE

6 fully equipped cathode ray tube service depots provide better, quicker tube testing should the need arise. Stocks of tubes are available in 26 Ediswan Offices. Only Ediswan give such complete backing to the Trade.

EDISWAN
MAZDA

ALUMINIZED CATHODE RAY TUBES

THE EDISON SWAN ELECTRIC COMPANY LIMITED,
155 Charing Cross Road, London, W.C.2 and Branches.
Member of the A.E.I. Group of Companies.

OSMOR

radio products ltd.

(Dept. W.60) 418 BRIGHTON RD, SOUTH CROYDON, SURREY. *Telephone Croydon 5148/9*

These really powerful units in compact form give quality and performance right out of proportion to their midget size and modest cost. Osmor "Q" Coilpacks have everything that only the highest degree of technical skill can ensure—**extra selectivity, super sensitivity, adaptability.** Size only 1⅞ x 3½ x 2½ with variable iron-dust cores and Polystyrene formers. Built-in trimmers. Tropicalised. **Prealigned.** Receiver-tested and guaranteed. Only 5 connections to make. All types for Mains and Battery superhets, and T.R.F. receivers. Ideal for the reliable construction of new sets, also for conversion of the 21 Receiver, TR.1196, Type 18, Wartime Utility and others. Send to-day for particulars!

SEPARATE COILS 4/-

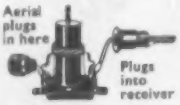
A full range is available for all popular wavebands and purposes. Fully descriptive leaflets and connection data available. (Optional) new simple fixing 2d. extra. Just note these "5 Star" Features. • Only 1in. high. • Packed in damp-proof containers. • Variable iron-dust cores. • Fitted tags for easy connection. • Low loss Polystyrene formers. L. or M.W. T.R.F. REACTION COIL TYPE QR 11-12, 4/9.

A range of coils for F.M. Receivers shortly available.

A special design of coils now available for reflex circuits.

OSMOR STATION SEPARATOR

The Separator may easily be tuned to eliminate any one station within the ranges stated and fitting takes only a few seconds. Sharp tuning is effected by adjusting the brass screw provided.



TYPE	METRES
1	141-250
2	218-283
3	267-341
4	319-405
5	395-492
6	455-567
7	1450-1550
8	410-550 k/c.

7'6 COMPLETE

CHASSIS CUTTER

Type	Hole Sizes	Prices
1	1in. x 1⅛in.	19/6
2	⅞in. x 1⅛in.	18/9
3	⅞in. x 1⅛in.	22/6
4	1⅛in. x 2in.	27/3

Illust. list on request.

I.F.s. 465 k/c. Permeability-tuned with flying leads. Standard size 1⅛in. x 1⅛in. x 3½in. For use with OSMOR coilpacks and others, 14/6 pair. Midget I.F.s. 465 k/c. ⅞in. x ⅞in. x 2⅛in., 21/- pair. PREALIGNED. 1/6 extra, both types.

FREE! Send 5d. (stamps) for fully descriptive literature including "The really efficient 5-valve Superhet Circuit and Practical Drawings," 6-valve ditto, 3-valve (plus rectifier) T.R.F. circuit, Battery portable superhet circuit, Coil and Coilpack leaflets, Chassis Cutter leaflet, and full radio and component lists, and interesting miniature circuits, etc.

DIALS—VARIOUS DIALS CALIBRATED TO COILS
Metal dials, overall size 5⅛in. square. Cream background, 3-colour Type MI, L.M.S. waves. M2, L. & M. waves. M3, M. and 2S. waves. Price 3/6 each.
Pointer 1/6; Drum, Drive, Spring and Cord, 3/2.
Type A glass dial assembly, measuring 7in. x 7in. (9½ x 9½ overall). Mounts in any position. Choice of two 3-colour scales, 24/6. P. & P. 1/6.

OUR TECHNICAL DEPT. WILL BE PLEASED TO ANSWER (BY LETTER ONLY) ANY ENQUIRY RELATING TO CIRCUITS IN WHICH OSMOR COILS OR COIL PACKS ARE USED OR ARE INTENDED TO BE USED.

WE ENDEAVOUR TO KEEP ABREAST OF THE TIMES BY BUILDING THE VARIOUS CIRCUITS PUBLISHED IN "WIRELESS WORLD," "PRACTICAL WIRELESS," "RADIO CONSTRUCTOR" ETC. WE KEEP STOCKS OF THE COMPONENTS SPECIFIED.

"PRACTICAL WIRELESS"
Coronet Four; Beginners' Superhet; Modern High Power Amplifier 2; Attache Case Portable; R1155 Converter; A.C Band-Pass 3; Modern 1-Valver; 3-speed Autogram, modern reflex, etc.

"WIRELESS WORLD"
"No Compromise" TRF Tuner. "Midget Mains Receiver." Sensitive 2-valve Receiver. Television Converter (special coils in cans available), Midget sensitive T.R.F., etc.

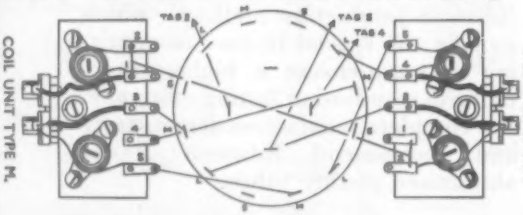
"RADIO CONSTRUCTOR"
Converting the TR1196 receiver to a general purpose superhet receiver simple crystal diode set. Radio feeder units. Economy 8 W.P.P. Amplifier. Circuit and details available for adding push-pull to the 5/6 valve Osmor superhet.

A LIST OF FIXED CAPACITIES AS REQUIRED FOR SWITCH TUNING AVAILABLE ON APPLICATION.

'Q' COIL UNITS MAKE EASY SWITCHING

Wavebands may be added or changed in a few minutes. Switching arrangements can be increased as required. Multi waveband Coilpacks may be easily made up. The Coil Unit consists of Aerial and Oscillator Coils and Trimmers wired and ready to connect to switch.

COIL UNIT TYPE M.



COIL UNIT TYPE L.

THE SIMPLEST AND MOST CONVENIENT METHOD OF SET BUILDING SO FAR DEVISED FOR THE AMATEUR.

15/- PER UNIT including 4 foolproof drawings.

NEWCOMERS TO RADIO: WE HAVE A NEW DEPARTMENT READY AND WILLING TO HELP

DESIGNERS ARE ASSURED OF FULL CO-OPERATION

Please let us know your requirements — send us your problems.

Why we recommend

THE **Playtime**

TAPE RECORDER

There is no other equipment at such a low price capable of the high performance of the "Playtime." You will want to possess this remarkable recorder, giving you a new world of entertainment and pleasure!

The smallest and lowest-priced Tape Recorder giving ONE hour's playing time. This sensational recorder is now available from our stock.

The 'PLAYTIME' Tape Recorder

makes an ideal Xmas-Gift—make sure you buy one in time—the demand is great—so order now!

ACCESSORIES

Matching High Fidelity Crystal Microphone	52/-
ONE HOUR Spool pecially matched tape	26/6
or Complete with all Accessories	£31/4/6

Carr. and Packing, 12/6.

26 GNS.

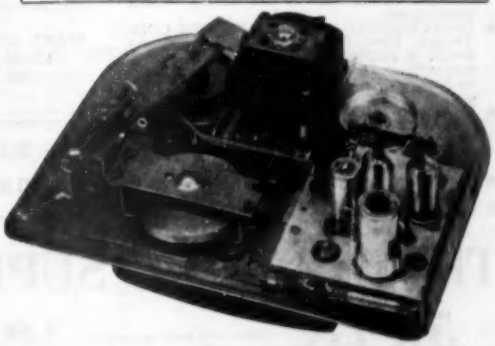
SPECIFICATION

- ***LIGHT IN WEIGHT***—only 16 lbs.
- ***LOW IN PRICE***—only 26 gns. or complete with high fidelity matched crystal microphone and ONE HOUR spool laboratory matched tape for £31 4s. 6d.
- ***SINGLE KNOB CONTROL*** by joystick for record, playback, rewind and fast forward without unlacing tape.
- ***SELF-CONTAINED*** for Recording, and Playback through any Radio or amplifier thus making possible high fidelity reproduction through the system used.
- ***UNIFORM FREQUENCY RESPONSE*** between 60-6,000 c/s.
- ***COMPACT AND SMALL***—overall size only 12½in. × 10in. × 4½in.
- ***ATTRACTIVE APPEARANCE***—finished in 2-tone leathercloth with detachable lid and handsome gilt fittings.
- ***FULLY AUTOMATIC*** operation and erasure.
- ***FOR USE*** on 220-250 v. A.C. 50 c/s.
- ***POWERED*** by specially designed motor.
- ***HIGH FIDELITY*** twin track recording heads completely enclosed in handsome dress cover affording complete protection against stray magnetic and electrostatic fields.

Buy it under the

M.O.S. PERSONAL CREDIT PLAN.

Send only 20% deposit with balance over 12 or 18 months.



THIS IS THE CHASSIS AND TAPE DECK OF THE 'PLAYTIME' —THREE YEARS IN DEVELOPMENT, IT IS SCIENTIFICALLY DESIGNED AND PRECISION ENGINEERED.

M·O·S

See it and hear it at the RADIO CENTRE

E. & G. **MAIL ORDER SUPPLY CO.**

THE RADIO CENTRE

33 TOTTENHAM COURT ROAD · LONDON · W.1 MUSeum 6667

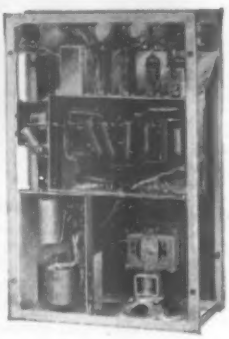
You can use Pre-recorded Tapes

WITH THE **Editor** SUITCASE TAPE RECORDER

The Economical, Multi-purpose TWO-SPEED Tape Recorder

AT **ONLY 45 GNS.**

Carriage and packing 15/-.



Simple to operate, the Editor is in use throughout the world for many different purposes. Easy to carry—easy to look at. Operating height only just over 5in. The "EDITOR" is the smallest, mains-operated portable tape recorder using 7in. spools on the market.

The Editor's ingenious circuitry is built on a quickly removable, all-steel frame—a remarkable development in chassis construction.

SPECIFICATION

★ Tape speeds 7½in. and 3¾in. per second ★ Twin-track heads.
★ Three specially designed recording motors provide fast forward run and 50 sec. rewind without unlacing tape.
★ INDEPENDENT BASS AND TREBLE CONTROLS FOR RECORDING AND PLAY-BACK ★ Negligible wow and flutter ★ 1,200ft. tape will provide TWO hours playing time. ★ Amplifier may be used independently for high quality record production.
★ High fidelity Recording head ★ Provision for external speaker ★ 4 watts output ★ Positive servo braking on all functions ★ Compact size for ease of handling, only 16½in. × 12in. × 5in. (with lid 7in.) ★ 200-250 v. A.C. mains.
★ Radio/Gram. and Microphone Inputs ★ Automatic Erasure.
★ Drop in Tape Loading.

ACCESSORIES

The "Editor" is supplied ready for use complete with 1,200ft. spool of high coercivity Tape and Ronette desk microphone.

SPARE SPOOLS OF TAPE.

1,200ft. spool	35/-
600ft. spool	21/-

★ **M.O.S. PERSONAL CREDIT PLAN** *Send only* 10% *Deposit. Balance over* 12, 18 *or* 24 *months.*

The "EDITOR SUPER" is now available

55 GNS. *Carr. and packing 15/-.*

Or 10% *Deposit. Balance over any period up to* 24 *months.*

A de luxe version of the "Editor," with many attractive facilities, such as "mixing" of inputs; all-leather suitcase; new design super tape deck.

Come and see it at The Radio Centre

M·O·S

E. & O.E. **MAIL ORDER**

Telephone: MUSeum 6667. *THE RADIO CENTRE*

Designed to obtain the best results from Modern Gramophone Technique

The BURGOYNE *Custom Built*

8-Valve Superhet

RADIOGRAM CHASSIS

With a push-pull output giving 8 watts of undistorted quality reproduction and using negative feedback, this fine chassis is supplied for those connoisseurs wanting only the best, at a price within their means.

TWO YEARS' GUARANTEE

Our faith in this chassis is such that we offer with every chassis sold a two years' guarantee (Valves subject to maker's usual guarantee).

22 GNS.

Carriage and packing 7/6.

EASY H.P. FACILITIES

Send only 10% deposit, balance over any period up to 18 months.

TECHNICAL DATA

- ★ Illuminated full vision coloured tuning scale 11¼in. × 6¼in.
- ★ Negative feedback.
- ★ 8 valves—6C9, 6F15, 6LD20, 6L1, (2)—6P25, UU7 and 6MI.
- ★ Separate bass and treble controls for cut and lift.
- ★ Wave bands 16-50; 190-550; 1,000-2,000 metres.
- ★ Magic eye tuning indicator and precision flywheel tuning.
- ★ 8 watts push-pull output.
- ★ Heavy gauge steel chassis, specially treated against corrosion.
- ★ Special mains transformer with smoothing circuit reduces hum to a minimum.
- ★ Clear long-distance reception.
- ★ Recommended for use with 10in. or 12in. P.M. speaker.
- ★ Speech coil impedance 3 or 15 ohms.
- ★ Extension speaker sockets.
- ★ Size 9¼in. high × 13in. wide × 8in. deep—chassis height 2¼in.

RECOMMENDED LOUDSPEAKERS

WB HF1012 · GOODMANS AXIOM 150

WHARFEDALE GOLDEN 10

All available from stock.

BUY THE M·O·S WAY!

Possess that Gear you have always wanted by using our Personal Credit Plan.

- *LOW DEPOSIT*
- *REASONABLE CHARGES*
- *PERSONAL SERVICE*
- *AT THE RADIO CENTRE*
- *QUALITY EQUIPMENT*
- *EASY REPAYMENT*

M.O.S. PERSONAL CREDIT PLAN

The deposit may be any amount convenient to the purchaser, but must be at least one-tenth of the total of Cash Prices for any item or items (which may be grouped).

The balance remaining when the deposit is subtracted from the total cash price may be spread over 6, 12, 18 or 24 months, and for these periods the charges are on a sliding scale.

For 6 months add 2/- in the £ to the Balance.
" 12 " 2/6 " " "
" 18 " 3/6 " " "
" 24 " 4/- " " "

Minimum rates are necessary because administration costs are fixed for every transaction, no matter how small, and are as follows:—

20/- where the balance is £5 or under.
30/- " " " £10 "
40/- " " " £15 "

• H.P. agreements for 24 months should be not less than £50 value.

SEND OR BRING US YOUR ORDER TODAY WITH SECURING DEPOSIT. OUR RANGE OF MERCHANDISE IS UNSURPASSED.

Please add sufficient to allow for carriage and packing.

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33 Tottenham Court Rd., London, W.1 *Telephone : MUSeum 6667*

VOLTAGE STABILISERS

Cold cathode gas filled regulator tubes provide a sensibly constant output voltage from a source of supply liable to fluctuation, and under conditions of variable load, within certain limits dependent on the rating of the tube. They may also be used in cascade to obtain still greater reduction of output voltage fluctuations and in combinations of series and cascade connection.

Type	Base	Dimensions (maximum)		Striking Voltage (maximum)	Operating Voltage	Ignition Electrode Voltage	Ignition Electrode Resistance (Megohms)	Maximum Tube Current	Minimum Tube Current	Regulation over Current Range (Volts)	American Equivalent	CV Number
		Length mm.	Diameter mm.									
QS. 75/20	B7G	54	19	110	75	—	—	20	2	6	—	284
QS. 75/60	B8G	80	30	117	75	—	—	60	5	5	—	434
QS. 92/10	BRITISH 4-PIN	85	33	140	92	—	—	10	1	5	—	188
QS. 95/10	B7G	54	19	110	95	150	0.25	10	2	5	—	286
QS. 108/45	B8G	80	30	120	108	150	0.1	45	5	5	—	422
QS. 150/15	B7G	54	19	170	150	240	0.25	15	2	5	—	287
QS. 150/40	I.O.	105	39.5	180	150	—	—	40	5	5.5	OD3	216
QS. 150/45	B8G	80	30	170	150	200	0.1	45	5	5	—	395
QS. 1200	B7G	54	19	180	150	—	—	15	5	3	—	2225
QS. 1201	FLYING LEADS	80	19	110	75	—	—	15	2	4.5	—	—
QS. 1202	FLYING LEADS	80	19	133	108	—	—	15	2	4.5	—	—
QS. 1203	FLYING LEADS	80	19	180	150	—	—	15	2	4.5	—	—
QS. 1204	B7G	54	19	133	108	—	—	15	2	4.5	—	—
QS. 1205	I.O.	105	39.5	105	75	—	—	40	5	6.5	OA3	3798
QS. 1206	I.O.	105	39.5	133	108	—	—	40	5	5.5	OC3	686
QS. 1207	B7G	67	19	185	150	—	—	30	5	2.0	OA2	1832
QS. 1208	B7G	67	19	133	108	—	—	30	5	2.0	OB2	1833
HIGH STABILITY TUBE												
QS. 83/3	B7G	54	19	130	83	—	—	5	1	0.6	5651	449

RADIO FREQUENCY HEATING VALVES

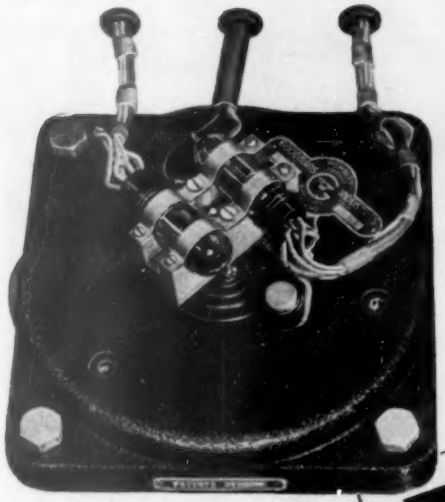
English Electric Valve Company has developed two valves to meet the urgent needs of Radio Frequency Heating. They have been specially designed for this purpose and may be obtained in either air cooled or water cooled versions.

DATA

	BR 1102 BW 1102	BR 1103 BW 1103
Filament Voltage*	8.2 V	6.0 V
Filament Current (nominal)	230 A†	120 A‡
Peak Usable Cathode Current	45 A	16 A
Anode Voltage (D.C.)	12 kV max.	8.5 kV max.
Anode Dissipation	20 kW max.	10.0 kW max.
Grid Dissipation	1 kW max.	600W max.
Amplification Factor (at Va=9.0 KV, Ia=1.5 A)	42	
Amplification Factor (at Ea=5.0 KV, Ia=1.0A)		25
Mutual Conductance (at Va=9.0 KV, Ia=1.5 A)	20 mA/V	
Mutual Conductance (at Ea=5.0 KV, Ia=1.0 A)		8.3 mA/V
Operating Frequency (for full ratings)	50 mc/s max.	100 mc/s
TYPICAL OPERATING CONDITIONS (OSCILLATOR)		
Filament Volts	8.2 V	6.0 V
Anode Volts (D.C.)	12 kV	8.5 kV
Anode Current (D.C.)	5.5 A	2.75 A
Grid Current (D.C.)	1.4 A	0.75 A
Grid Volts (D.C.)	−740 V	−510 V
Grid Resistance	530 ohms	670 ohms
Anode + Grid Dissipation	17.5 kW	8 kW
Power Output	47.5 kW	15 kW

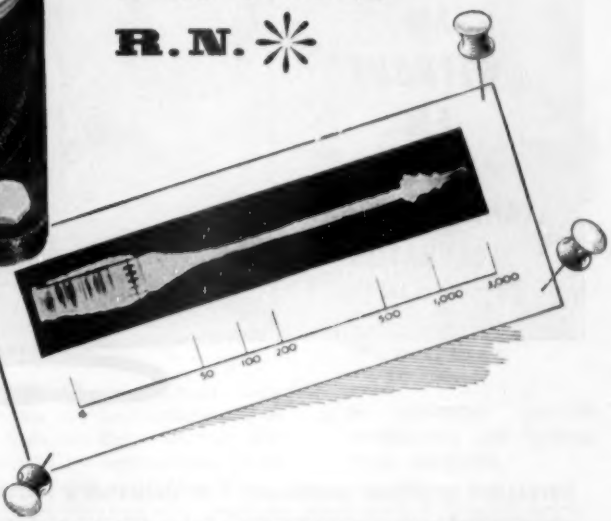
*Thoriated Tungsten Filament.
†The starting filament current must not exceed 525 A, even momentarily, at any time.
‡The starting filament current must not exceed 260 A, even momentarily, at any time.

ENGLISH ELECTRIC VALVE COMPANY LIMITED
WATERHOUSE LANE, CHELMSFORD, ESSEX



BRIMAR

Pin down R.N. ✳



Illustrations by courtesy of Standard Telephones and Cables Limited who say, "These vibrators have been chosen as they give a faithful reproduction of the input wave form and enable high accelerations at any frequency to be obtained."

with GOODMANS VIBRATORS

✳ RESONANCE NOISE describes a particular factor in a valve which can very seriously impair its otherwise good characteristics. Only when "R.N." is negligible can a valve operate strictly according to its published "curve" and data.

Complete investigation of this phenomenon is only possible by subjecting the valve to *controlled* vibration throughout a wide frequency range. If the valve is operated in a Class A circuit, and the A.C. noise voltage appearing at the anode of the valve is presented on an oscilloscope, a resonance diagram against input frequency can be obtained. By this means it is possible to excite the valve in the range of frequencies 20 to 10,000 c/s, and the resonance noise performance checked. By the use of a twin mounting as illustrated, comparisons of valves can be made under identical conditions.

Just another of the wide applications of Goodmans Vibration Generators. Perhaps "controlled vibration" can serve you also.

The range includes models developing a force of ± 300 lbs. to the midget model with a force output of ± 2 lbs. for optical-cell research and hairspring torque testing etc. Full technical data available from "Vibration Division W"

GOODMANS INDUSTRIES LIMITED
AXIOM WORKS, WEMBLEY, MIDDX.
Phone: WEMbley 1200 (8 lines)

GD

UNDISTORTED 100% MODULATION

AM *WITHOUT* FM

WITH THE

STANDARD SIGNAL GENERATOR

TYPE TF867

EXCELLENT amplitude modulation is an outstanding feature — a.m. accompanied by unmeasurable f.m. Other features include :

Wide Range: 15 kc/s to 30 Mc/s on 15 ft. high-discrimination full-vision scale.

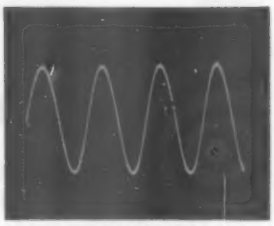
Crystal Accuracy: 0.01% with built-in 1 Mc/s harmonic source.

High Output: 4 volts down to 0.4 microvolts.

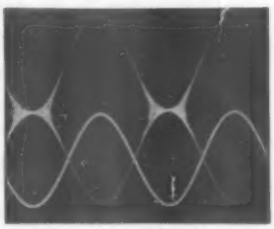
Flexible Modulation: Internal 400 and 1,000 c/s, external 50-10,000 c/s within a db.

Also incorporated: Automatic level control, overall negative feed-back from r.f. output to modulation input, modulation monitoring by dual-rectification and variable impedance termination with animated diagram.

A signal generator also ideal as a video oscillator for wide-band television systems.



15 kc/s Unmodulated Carrier showing good waveform.



320 kc/s Carrier modulated at 400 cps—audio source on lower trace shows fidelity.

TEST OSCILLOGRAMS

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SIGNAL GENERATORS · VALVE VOLTMETERS · Q METERS · FREQUENCY STANDARDS
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Specially prepared sets of radio parts with which we teach you, in your own home, the working of fundamental electronic circuits and bring you easily to the point when you can construct and service radio sets. Whether you are a student for an examination; starting a new hobby; intent upon a career in industry; or running your own business—these Practical Courses are intended for YOU—and may be yours at very moderate cost.

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With these outfits, which you receive upon enrolment, you are instructed how to build basic Electronic Circuits (Amplifiers, Oscillators, Power Units, etc.) leading to complete Radio and Television Receiver Testing and Servicing.

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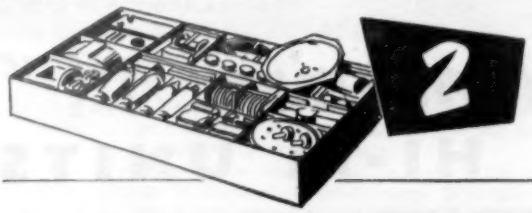
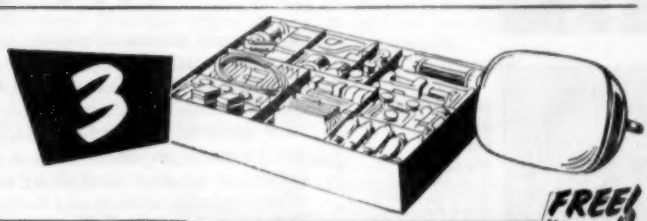
ALL EQUIPMENT SUPPLIED IMMEDIATELY AND REMAINS YOUR PROPERTY



RADIO Advanced—With this equipment, you are instructed in the design, construction, testing and servicing of a complete modern Superhet Radio Receiver.

TELEVISION Outfit No. 3—With this equipment you are instructed in the design, construction, servicing and testing of a modern high-quality 15" Television Receiver.



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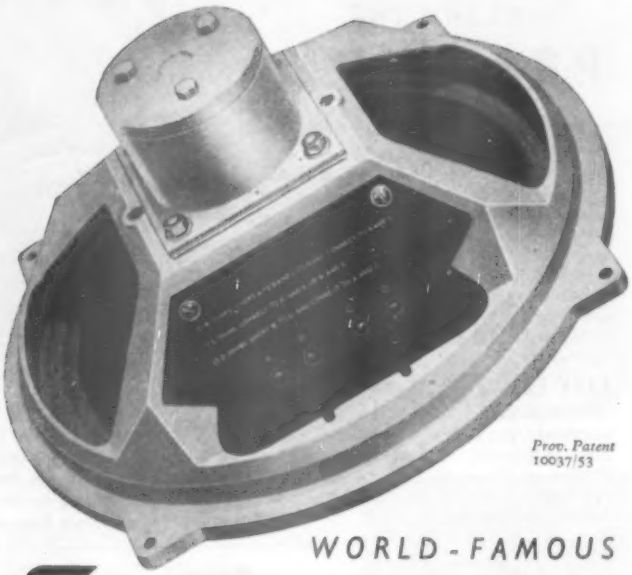
L. ORMOND SPARKES
Radio Consultant and Designer



Prov. Patent 10037/53

WORLD-FAMOUS

Stentorian CAMBRIC CONE HI-FI UNITS

ASTOUNDING REALISM of reproduction at amazingly low cost, made possible only by specialised designing and manufacturing resources. The patented Cambric Cone combines with high flux density Alcomax magnet, and robust die-cast chassis to produce a speaker unrivalled except at many times the price. Now available with exclusive universal impedance speech coil (at 3, 7·5 and 15 ohms) on models marked with an asterisk. Write for descriptive leaflets, or ask your usual dealer to demonstrate. Alternatively, these and other Stentorian speakers may be heard at our London Office (109 Kingsway, W.C.2) any Saturday from 9 a.m. to noon.

READY-TO-ASSEMBLE

BASS REFLEX CONSOLE CABINET

for 10" or 12" units, in polished walnut, size 32" x 22" x 16", **£10.10.0**

Corner Console Cabinet for 8" unit, **£5.10.0**

Full details on request.

LOOK AT THE PRICES!

Model HF510	5" Steel Unit ...	£1.17.6
,, HF510	5" Die cast Unit	£1.19.6
,, HF610	6" Steel Unit ...	£2.10.6
,, HF610	6" Die cast Unit	£2.12.6
,, HF810	8" Steel Unit ...	£3. 0.6
,, HF812*	8" Die cast Unit	£3. 5.6
,, HF912*	9" Die cast Unit	£3. 9.6
,, HF1012*	10" Die cast Unit	£3.17.6
,, HF1214	12" Die cast Unit	£9.15.6

(Tax Paid)

WHITELEY ELECTRICAL RADIO CO. LTD
MANSFIELD . NOTTS

(photograph by courtesy of E.S.A. Ltd., Stevenage)

This is a typical application of R.F. Heating as used in the Woodworking Industry, showing how shapes are manufactured with veneers. The jig is of laminated wood, in the form of the final shape, and is lined with aluminium sheets which are connected to the terminals of the R.F. Heater.
The pressure, which should be about 50 lbs. per square inch, is applied on the centre ram by means of a hydraulic pump. With this method the R.F. is fed to the two plates which cause the wood mass to become hot and the resin to cure in a few minutes.
Thus only one jig is required to give a large daily output and the cost of the job is thereby reduced. Less floor space is required than for any other method.
The main advantage of R.F. Heating over other methods, however, is that heating can be localised and heat will only be applied where it is needed.

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Messrs. H. F. Industrial Services Ltd., Fairfax Road, London, N.8. Telephone: Fitzroy 0045
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MESSRS. PYE LIMITED

R. F. HEATING DIVISION • RADIO WORKS • CAMBRIDGE • ENGLAND
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And NOW—a range of 'CERAMICAPS' for your LAB Storage Unit!

The LAB Continuous Storage Unit is widely acknowledged as the most efficient and convenient method of storing and selecting resistors. Now its usefulness is still further extended with the introduction of LAB pak'd 'Ceramicaps'. With the LAB Unit, research and experimental laboratories and small production groups have to hand immediately, a complete range of resistors and 'Ceramicaps', easily selected with card index simplicity from some 700 sorted and carded components. Empty cards are merely replaced with full ones from stock.

The LAB unit is supplied FREE with initial purchase to your specification. Standard assortments available. Each LAB Unit can be used to store one type of component exclusively, or quantities of the complete range of resistors and 'Ceramicaps'. Full details and illustrated list will be sent on application.

Ref.	Type	Loading	Max. Volts	Range	Dimensions
RESISTORS					
T	½ watt	¼ watt	250	10 ohms to 10 megohms	⅜" × ⅛"
R	½ watt	1 watt	500		⅝" × ¼"
Tolerance available ±20%, 10%, 5%					
HIGH STABILITY RESISTORS					
HSJ	½ watt	¼ watt	750	1 ohm to 500 megohms	1.1" × 0.1"
Tolerance available ±5%, 2% or 1%					
WIREWOUND RESISTORS					
5 ohms to 100K ohms — 5 - 10 watts					
'CERAMICAPS'					
Tubulars 3 - 470 pf 500 - 5000 pf			Tolerances ±2%, 10% Hi-K		

The Lab Continuous Storage Units are available from your normal source of supply, but more detailed information can be obtained from

THE LAB TESTED CONTINUOUS **STORAGE UNIT**

★ **Continuous Storage for Resistors and 'Ceramicaps'**

★ **Values separately carded**

★ **Finger-tip Selection**

THE RADIO RESISTOR COMPANY LTD

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AIRMEC

FREQUENCY STANDARD TYPE 761

THIS instrument has been designed to fill the need for a self-contained compact frequency standard of moderate cost and very high accuracy.

Sine wave and pulse signals are produced at five standard frequencies, the pulse waveforms being extremely rich in harmonics.

An oscilloscope complete with X and Y amplifiers is incorporated for visual frequency comparison, and a Beating circuit and loudspeaker for aural checking. Standard frequencies are switched to these two circuits internally, and their employment is therefore unaffected by connections made to the output plugs.

A synchronous clock driven from a voltage of standard frequency provides a time standard which may be maintained accurate to within a few seconds a year.

The instrument is enclosed in one of the Airmec range of cases which is suitable either for bench use or forward mounting on a 19in. rack.

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- **Outputs:** Outputs are provided at 100 c/s., 1 kc/s., 10 kc/s., 100 kc/s., and 1 Mc/s.
- **Waveform:** The above outputs are available, simultaneously with sinusoidal or pulse waveform from separate plugs.
- **Stability:** Four hours after switching on a short term stability of considerably better than 1 part in 10^8 is obtained.

Full details of this or any other Airmec instrument will be forwarded gladly upon request.

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If you would like further details of this really high fidelity recorder see your dealer to-day. In the event of difficulty, write enclosing a S.A.E. Due to to the large volume of orders taken during the Radio Show, there is 21 days delay in despatch. The "CONCERTONE" is worthy of the title British Manufacture, and well worth waiting for.

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Abridged Specification

Tape speeds, 7½in. and 3¾in./sec. Fast Forward and Rewind. Self-compensating Servomatic brakes. Single slot loading. Position scales. Inputs Mic., Rad. and Gram. Frequency response 7½in./sec. 50-10,000 cps. within 3db. 3¾in./sec. 50-6,000 cps. within 5db. Bias freq., 51 kc/s. Half track recording. Interlocked controls Wow and Flutter not more than 0.2%. max (completely inaudible). Recording to International Standard. Cabinet—Blue and Grey rexine. Storage for Mic. and Mains lead. Detachable lid. Gross weight, 26 lbs. For 200/250 v. A.C. ONLY.

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4. Is correctly heat-dried to preclude "blocking" and sticking, layer-to-layer, under storage conditions.
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9. The Kraft Paper base has been selected after careful development with the paper manufacturers—flexibility, and super-calendering being prime considerations.
10. The Lacquers are pigmented with the highest grade powder. The individual particle size is less than one micron (0.000039 inch).
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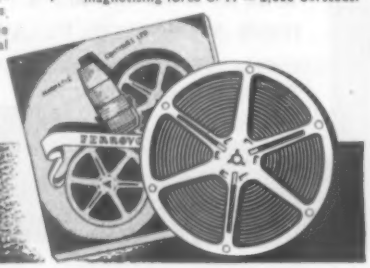

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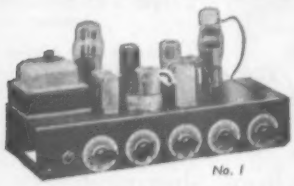

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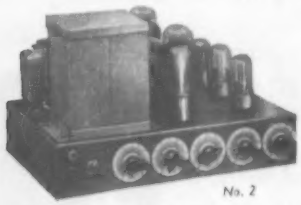
No. 1 "SYMPHONY" AMPLIFIER is a 3-channel 5-watt Gram/Radio Amplifier with astonishingly flexible tone control. You can lift the treble, the bass, or—and here is the unique feature—the middle frequencies to suit your own ear characteristics and the record or radio programme being heard. It is thus possible to arrange the frequency-response of the amplifier to a curve equal and opposite to the resultant curve of the other items in the chain so that what finally registers in the brain is as per original. This flexibility of control is far more important than mere nominal linear response of the amplifier, as the pick-up, speaker, etc., are not linear. Independent Scratch-Cut is also fitted and special negative-feedback circuit employed. The Amplifier can accommodate a wide variety of records from old 78's to new L.P.'s. Input is for all types of pick-up of 0.1v. output or more and there is full provision (and power) for Radio Tuner. It is available to match 2/3 or 15 ohms speakers. Price: **10 gns.** (carriage 5/-). Fitted in Portable Steel Cabinets, **35/-** extra.



No. 2

No. 2 "SYMPHONY" AMPLIFIER as No. 1 but with 10-watt Push-pull triode output and triodes throughout. Woden mains and output transformers and choke. Full provision and power for Tuner. Output tapped 3, 7.5 and 15 ohms. Competes with the most expensive amplifiers on the market yet costs only **15 gns.** (carriage 5/-). Fitted in portable Steel Cabinet **2 gns.** extra.

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MODEL TB as above, but with long pickup arm. Less heads, **£9/11/-**, post 2/6.
Heads to fit this unit: Decca XMS, 55/-, Decca Crystal, 35/-, Garrard Standard Magnetic, 25/-, miniature magnetic low impedance, 25/-, miniature magnetic high impedance, 35/-. Post on heads 1/-. Unit can be supplied with any combination of above heads and is carefully adjusted for stylus pressure on despatch.

MODEL RC80M, less heads, **£15/4/6**, with new turnover head, **£17/9/6**, with two separate Acos HGP35 heads, **£19/9/-**, carriage 5/-.

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DECCA Model 349C, as above, but fitted Decca crystal heads, same price. Carr. 7/6.

Illustrated leaflet on Collaro Products on request.

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CONNOISSEUR, 3-speed motor, **£23/8/11.**

GOODMANS CORNER CABINETS (left) for the AXIOM 150 Mark 2 manufactured by us to Messrs. Goodmans' measurements. Height, 44in. Price: complete kit in plain board with 1-in. thick telt, **8 gns.** Price ready built, **10 gns.** Finished in figured walnut, **16 gns.** Other veneers to order. Carriage extra according to area.

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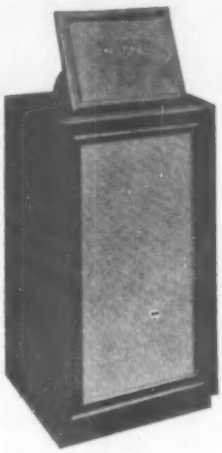

"SYMPHONY" BASS REFLEX CABINETS, fully finished in figured walnut, oak or mahogany to our own design and to match our Console Amplifier Cabinet, enabling the housing of a whole equipment in a two piece suite, cost: 12in. speaker model, **£11/10/-**; 10in., **£11**; 8in., **£10/10/-**. Carriage according to area. The 10in. model is ideal for the WB HF 1012 (see "The Gramophone" review March).

W.B. BASS REFLEX CABINET in Kit Form (veneered in figured walnut) to house HF1012 and Tweeter, **10 gns.** Carr. by Road, 10/-.

CONSOLE AMPLIFIER CABINETS (above), 33in. high, lift-up lid with piano hinge, take Tape Deck, Gram Unit or Auto-changer, Amplifier, Pre-amplifier, and Radio Feeder Unit, finished medium walnut veneer. De Luxe version, **10 gns.** carriage according to area. Other veneers 10/- extra.

OTHER PEOPLE'S AMPLIFIERS and Radio Feeder Units

If any reader should have his mind set on a high priced amplifier of another make but would like to save some money if possible, we should like to make the following clear-cut offer: If he buys one of our Symphony Amplifiers (Standard or Decca or Studio version) and is not entirely satisfied with it he may return it for full credit against *any other Amplifier on the market*. It should be emphasised at this stage that as Retailers we can supply any amplifier or Radio Tuner advertised in the "Wireless World" or "Gramophone."

HIGH FIDELITY LOUDSPEAKERS

We have made an extensive survey of the high-fidelity loudspeaker market and, after careful tests in our laboratory, we can recommend the following as representing the best value for money. The actual choice of a model is determined largely by the amount of money which can be allocated to this item, and we advise customers to get the best they can afford, as it is a very important item in the reproduction chain. The mounting of the speaker is just as important as the speaker itself, and for maximum results the speaker should be mounted in one of our Bass Reflex Cabinets (except the Axiom 150 which has its own cabinet). Advice freely given. If in town, call for a demonstration.

WHARFEDALE. Super 5, £6 13s. 3d. Super 8 CS (with cloth surround), 8in., £6 6s. 6d.; Super 8 CS AL (with aluminium speech coil), £6 13s. 3d.; Golden CS 10in., £8 6s. 7d.; W12 CS 12in., £9 15s.; Super 12 CS AL, £17 10s.; W15 CS, £17 10s.

GOODMANS: Axiom 101 8in., £6 12s. 1d.; Axiom 102 8in., £9 18s. 2d.; Axiom 150 Mark 2 12in. twin-cone model, £10 5s. 6d.; Audiom 60, £8 12s. 6d.; Audiom 60B, special 35 c.p.s. bass-resonance model to act as bass unit in twin-speaker outfits, £8 12s. 6d. New model Orlin III 12in., £9 15s.

WHITELEY (W.B.) Model HF 812, £3 5s. 6d.; HF 912, £3 9s. 6d.; HF1012, £3 17s. 6d These models are fitted with new universal impedance speech-coil, matching 3, 7.5 and 15 ohms. Model HF 1214, £9 15s. 6d. (15 ohms only). Metal-cone Pressure-Unit, 15 ohms, £3 15s. 6d. Special Crossover Unit to match, £1 6s. 6d., recommended for use in twin-speaker outfit employing the HF 1012 or HF 1214 as bass speaker.

G.E.C. New Mode' with metal cone 4 ohms impedance, £8 15s. Special matching transformer available to match this speaker to 15 ohms, 17s. 6d. Special octagonal cabinet in veneered walnut to G.E.C. specification for this speaker, £12 10s.

TANNOY. Direct Diffuser model (12in.), £10. Duo-concentric model (12in.) with crossover, £27 10s. Duo-concentric (15in.) with crossover, £33 10s.

E.M.G. FILTER. An infinitely variable Steep-Cutting Filter for insertion in the loudspeaker circuit to reduce surface noise on 78's, "edge" on some L.P.'s and heterodyne whistles on radio. Price, £4 10s.

WB. BASS REFLEX CONSOLE CABINET specially designed by Whiteley Electrical to house their HF 1012 10in. model together with the Pressure Unit and crossover. Both bass and treble units are housed inside the cabinet which measures 32in. high x 22in. wide x 16in. deep. The cabinet is supplied fully cut and ready veneered and polished and complete with speaker fabric but in Kit Form for easy home assembly. Price £10 10s. incl. packing. Carriage according to area. This cabinet fitted with the two above-mentioned units gives very pleasing results. Illustrated leaflet on request. Recommended Bass Speaker, £3 17s. 6d. Pressure Tweeter and Crossover Unit, 5 gns.

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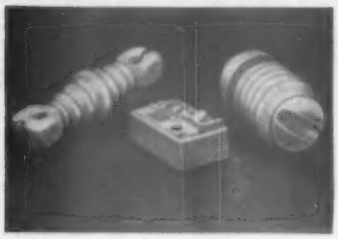

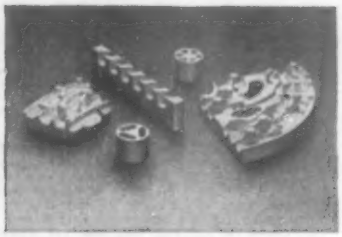

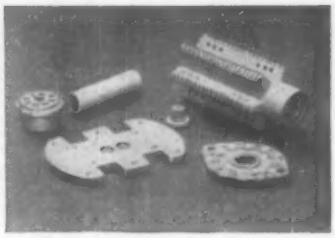

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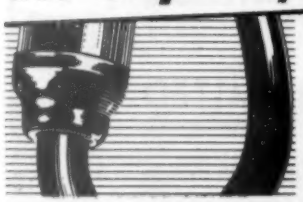

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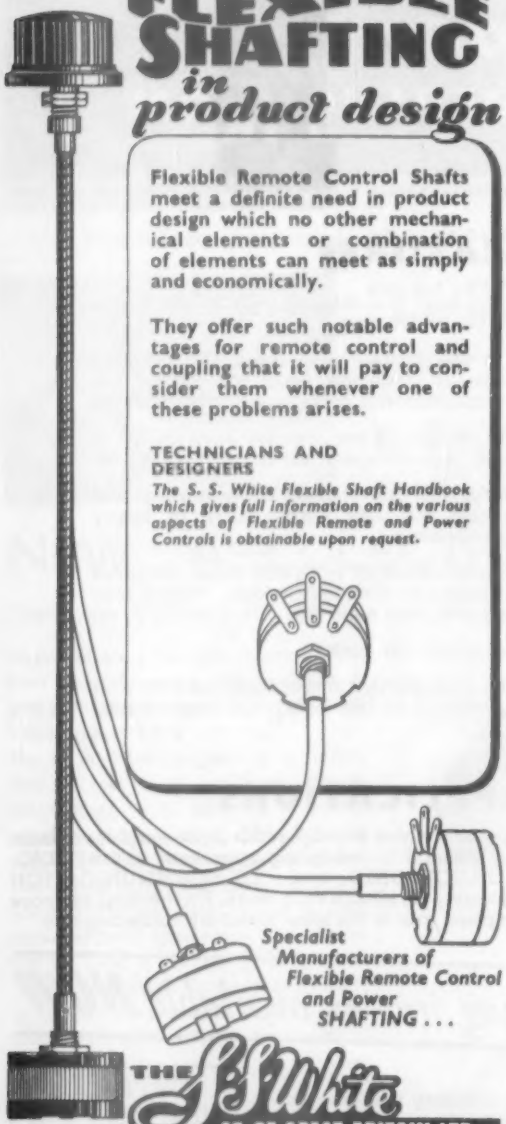

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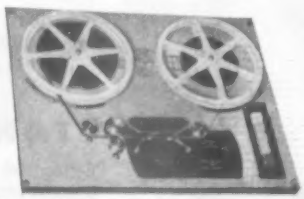
Expressly designed to **correctly** operate the TRUVOX Tape Deck Mk. III—for Recording and Playback through a 3 ohm speaker, also supplying power for erasure and biassing. Additional facilities are as (a) a pre-amplifier to feed a power amplifier for the playing of recordings at greater than normal volume (for auditorium purposes, etc.); (b) a pick-up amplifier to operate a loudspeaker direct from a gramophone pick-up; (c) a two-station radio receiver for direct listening or recording with a TRUVOX Radio Jack. **Three Input Jacks. Output:** 4 watts output at 3 ohms. **Oscillator:** Fixed frequency at approximately 45 kc/s. at high impedance. **Erase voltage** at least 150 v. **Bias** 80 v. approx. **Level indication** by Magic Eye. **Hum level:** 50 db down at 4 watts. **Frequency Response:** Fixed recording characteristic. Variable replay characteristics. Fixed level response as pre-amplifier. With TRUVOX heads and modern tapes, gives a substantially level response from 70-10,000 cps. **A.C. supply mains 110-250 v.**



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22 GNS List Price

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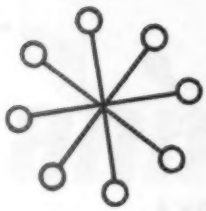
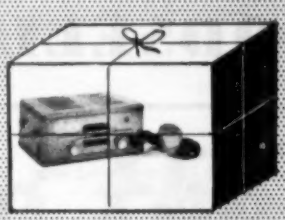
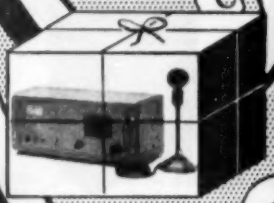
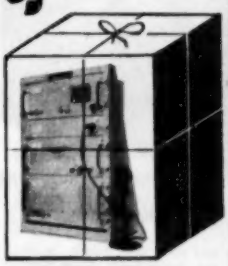


With best wishes for a Merry Christmas and a Prosperous New Year







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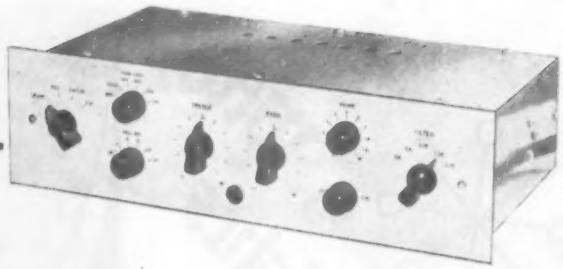

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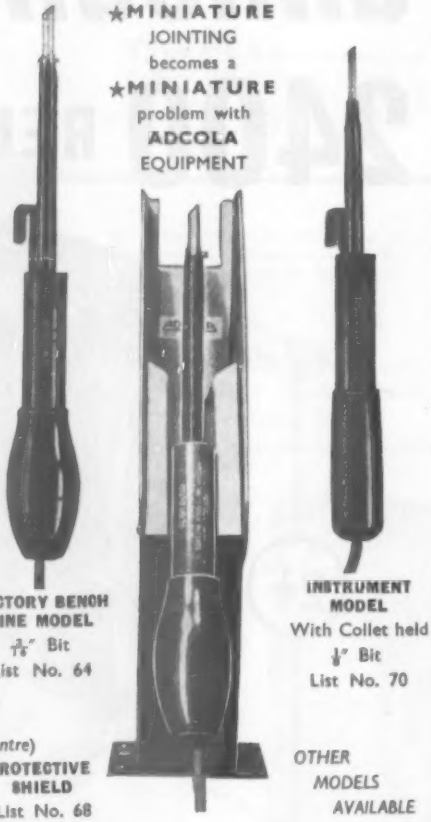

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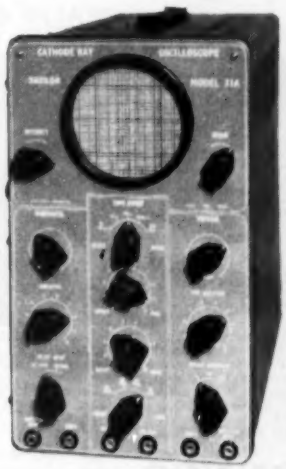

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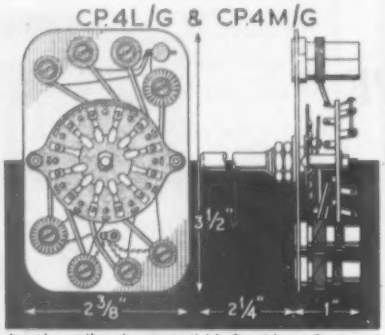

These compact 4 station coil packs are available for either 1 Long and 3 Medium wave stations (CP.4L/G) or 4 Medium wave stations (CP.4M/G). A gram position is provided in which no coils are in circuit and provision is made for switching in the pick-up circuit. They may be used with any standard frequency changer valve. I.F. 465 kc/s. Retail price of each unit: 31/- plus 10/4 P.T. = Total 41/4.
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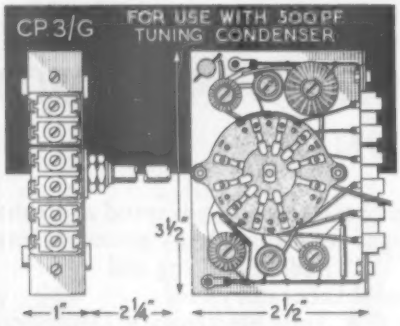

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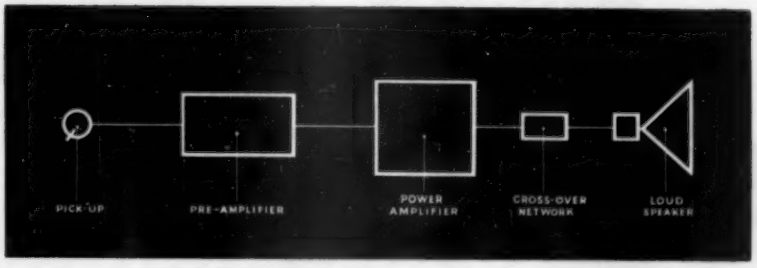

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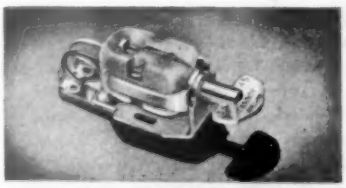

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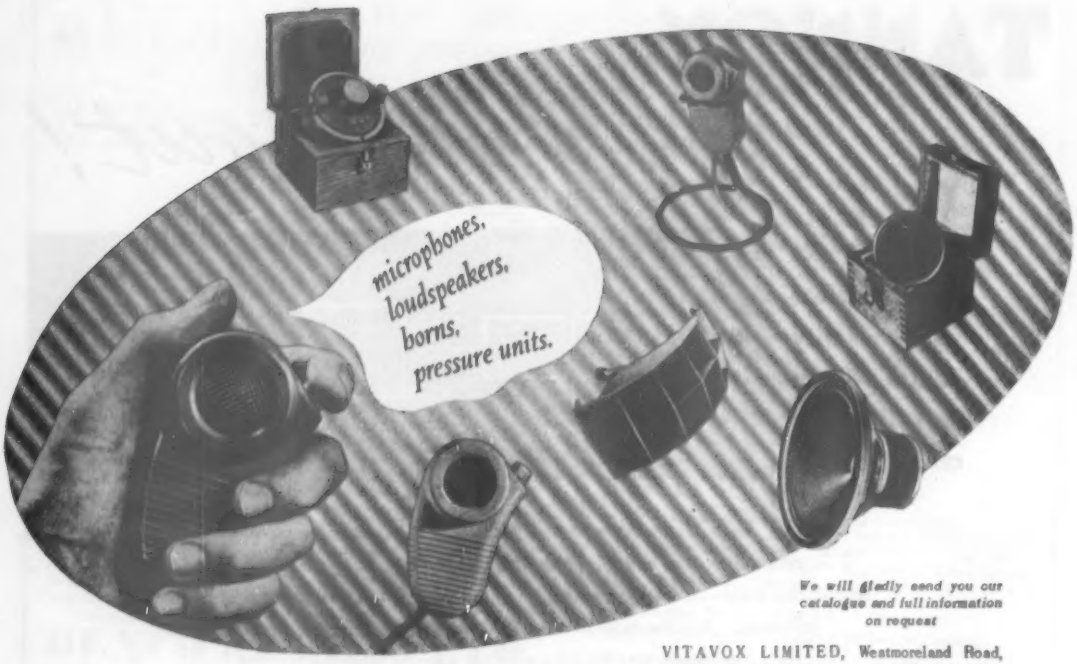

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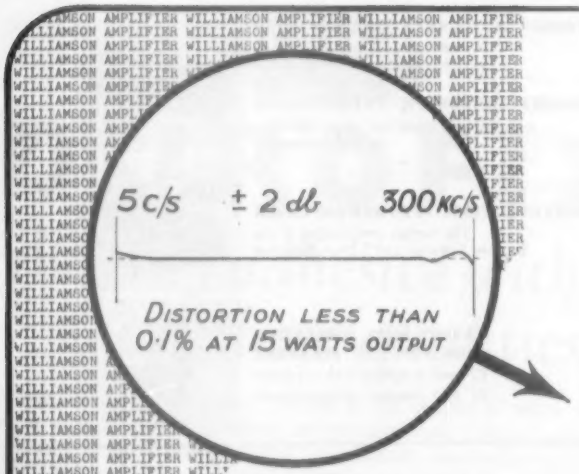

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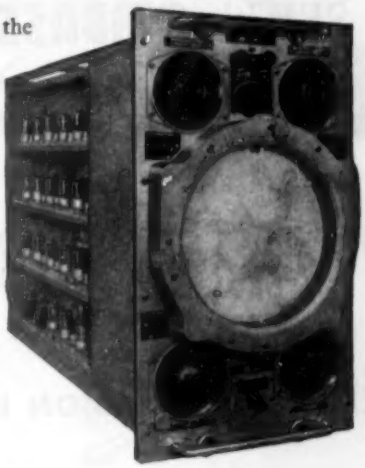

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Photo by courtesy of Grubb Engineering Co., Ltd.

Arrangement of magnets showing simple mechanical assembly

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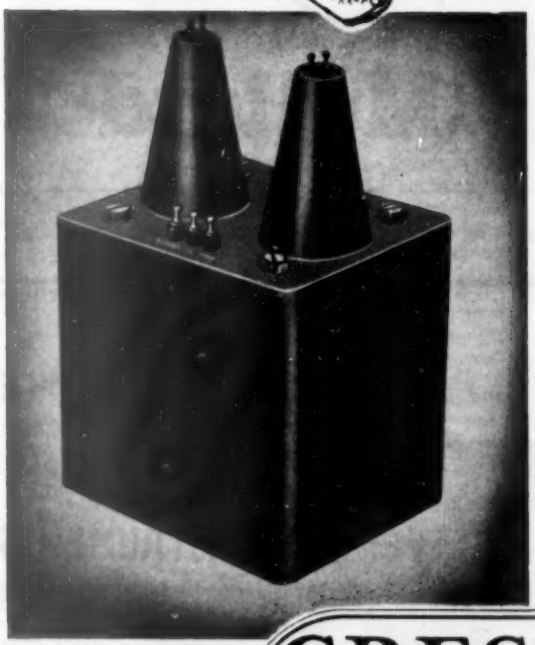

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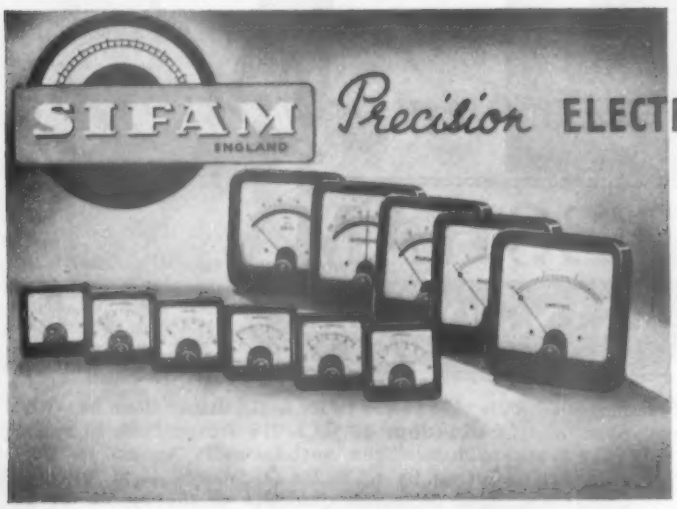

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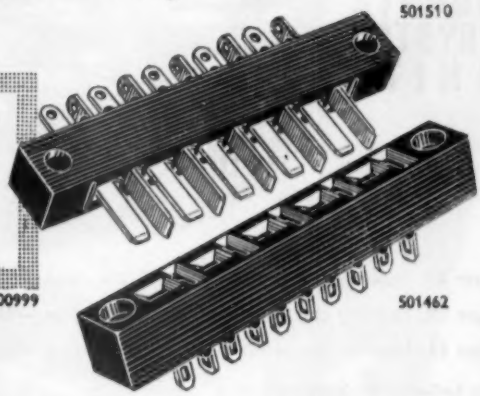

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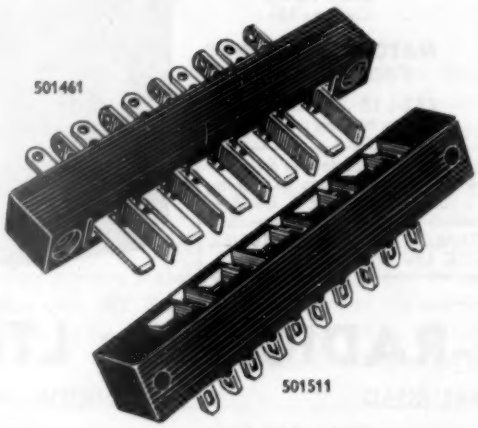

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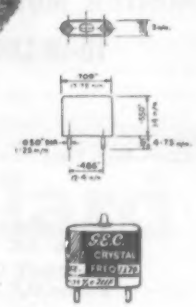

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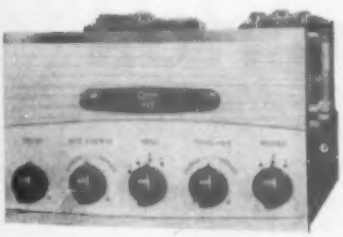

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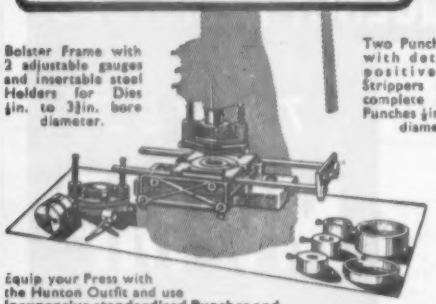

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INPUT RESISTANCE:
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On X 1 range 0.5 seconds; on other ranges 0.15 seconds.

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1 mA into 4000 ohms.
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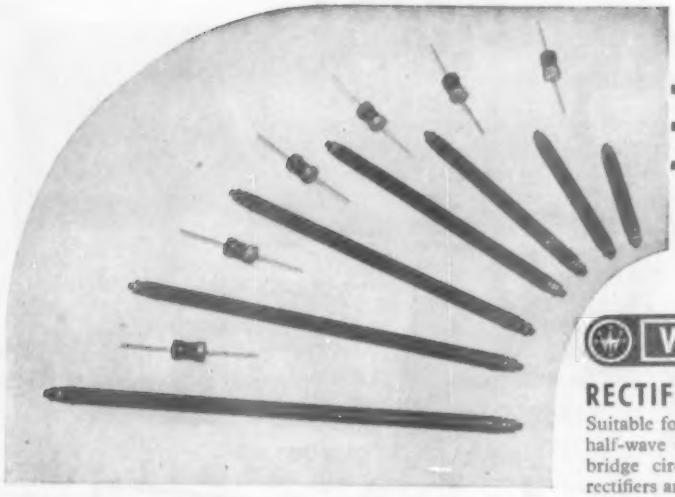

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16K1	15	15	15.5	15
16K7	105	113	108	102
16K16	240	240	248	240
16HT20	300	312	320	293
16HT40	600	624	640	580
16HT80	1,200	1,248	1,280	1,190
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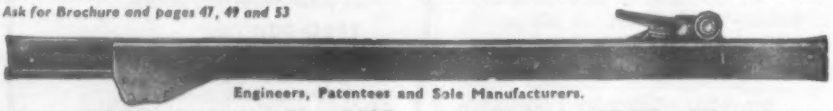

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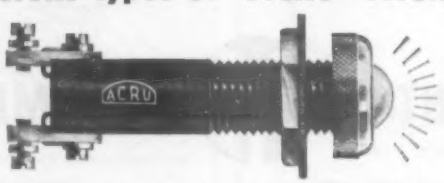

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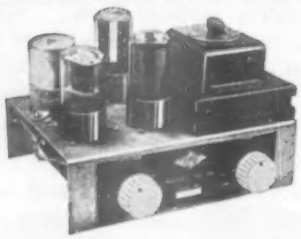

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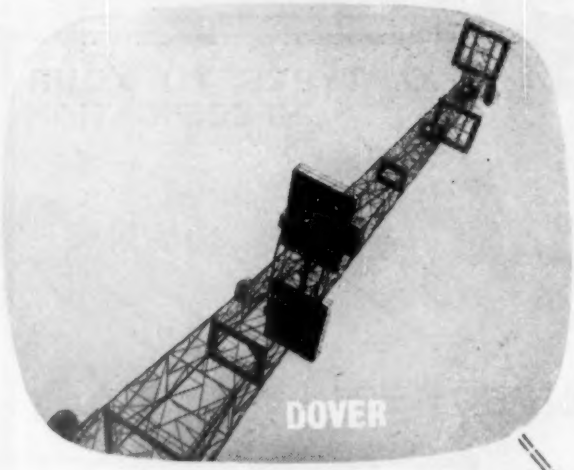

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The Wayne Kerr Video Oscillator is used by the B.B.C. Engineers to measure the frequency response of the Link over its full bandwidth.

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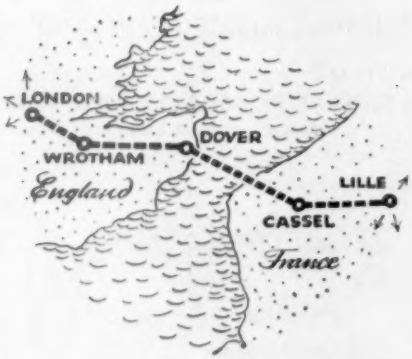

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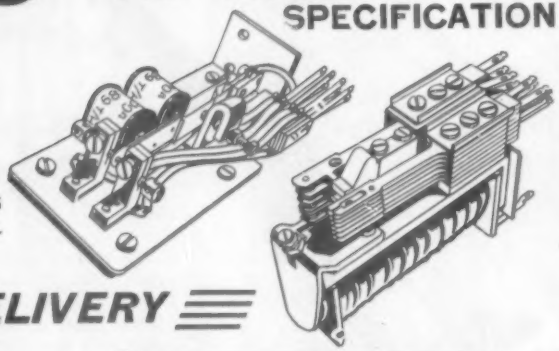

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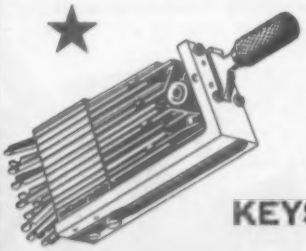

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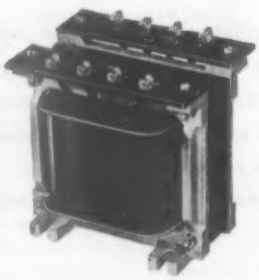

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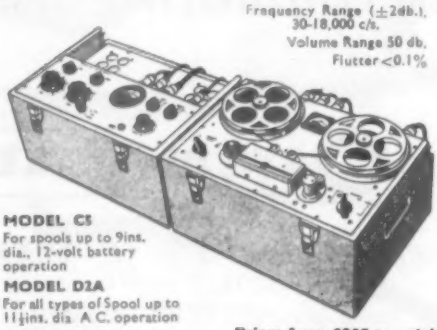

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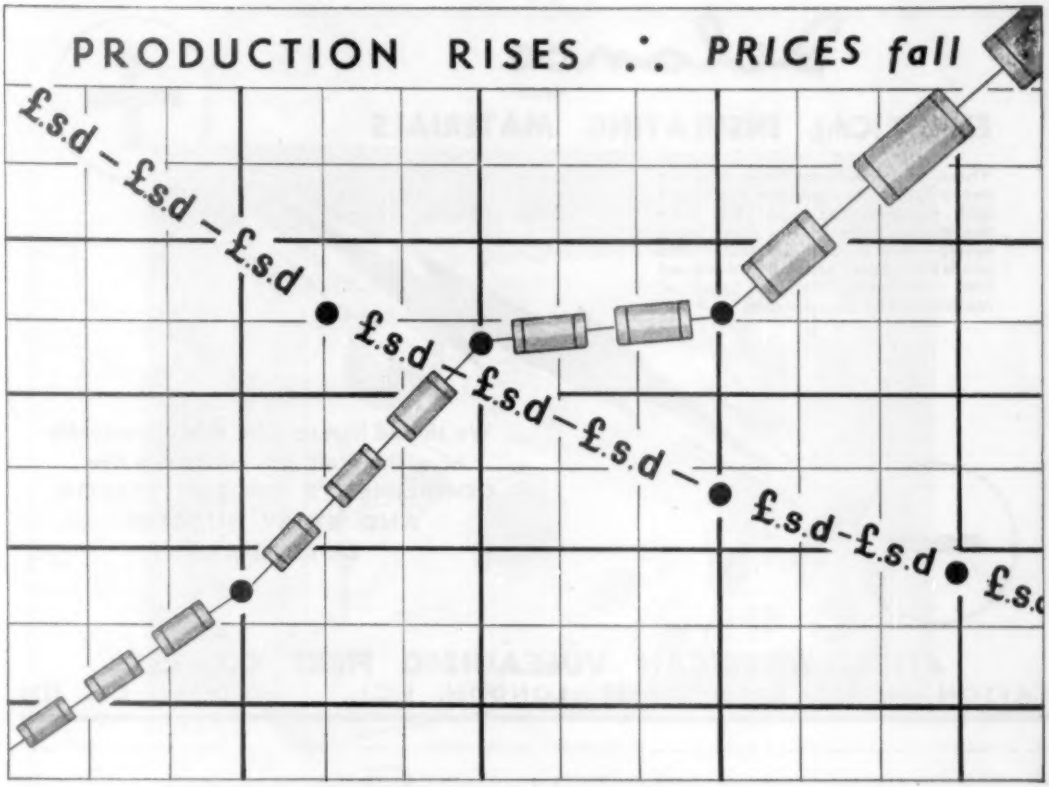

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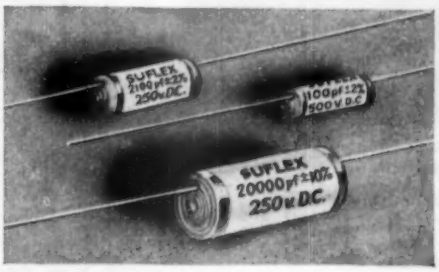

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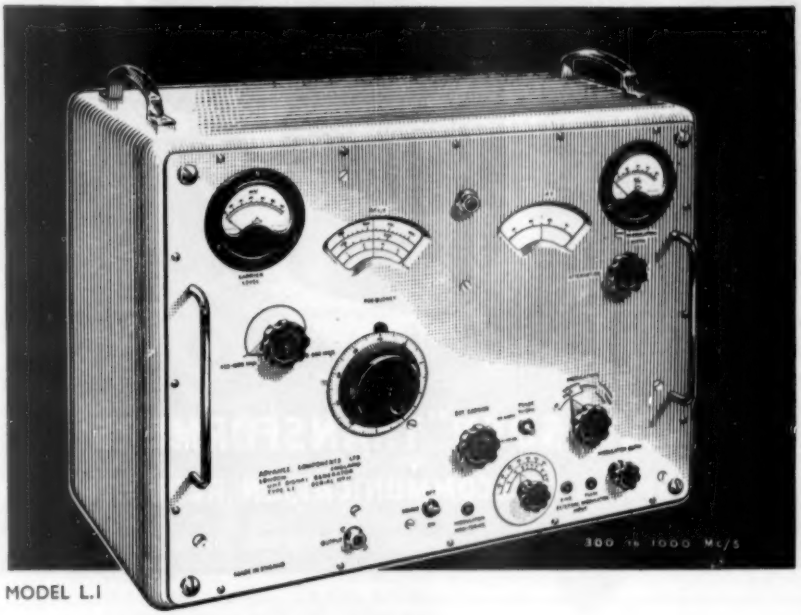

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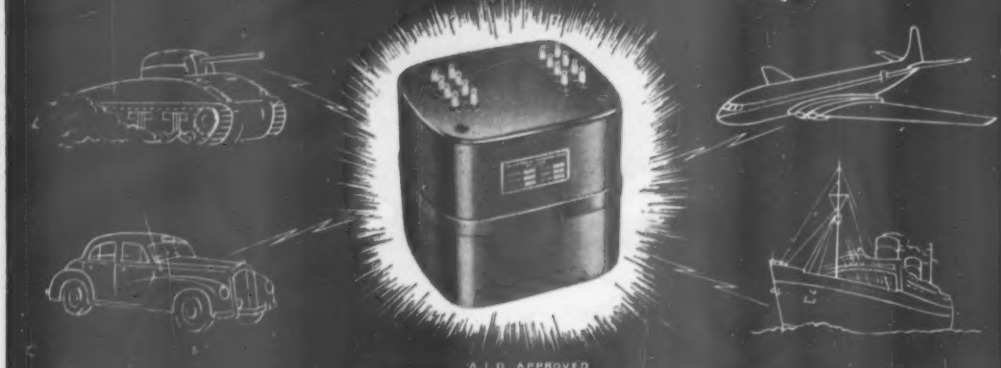

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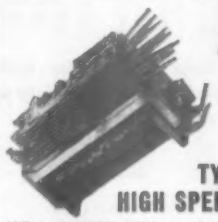

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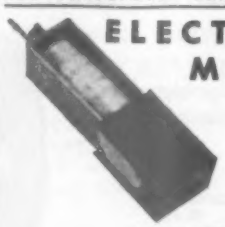

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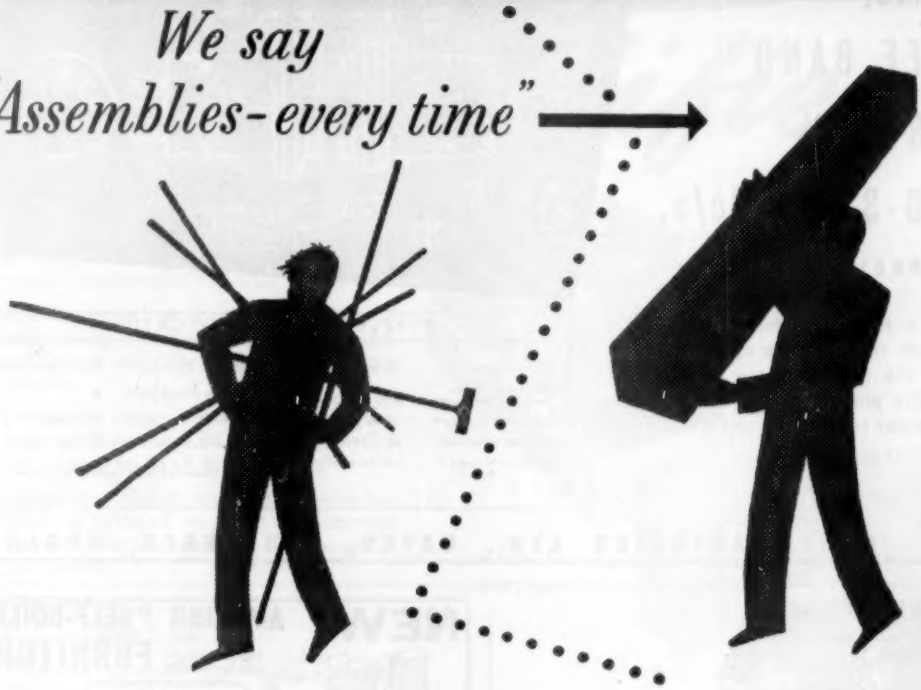

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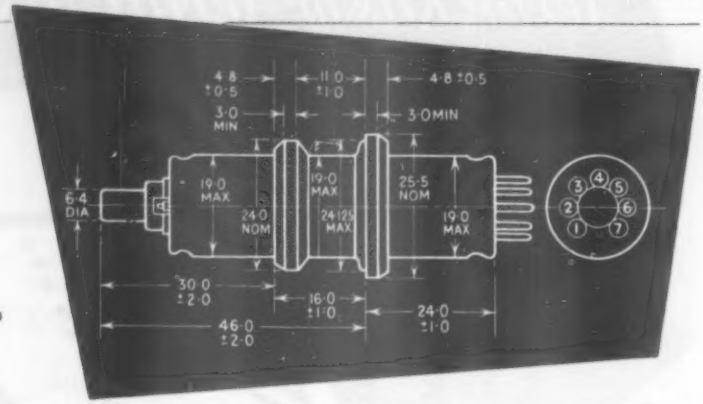

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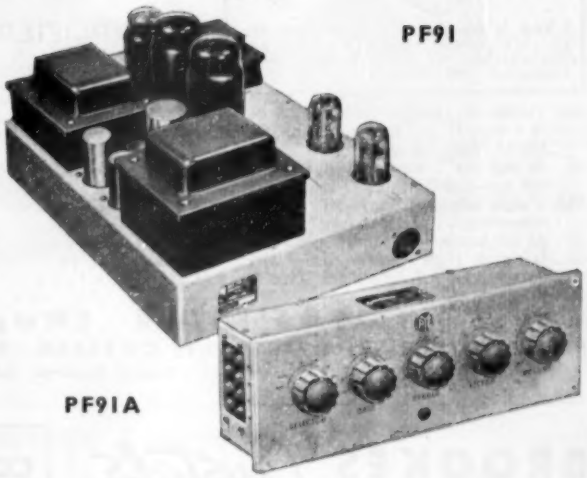
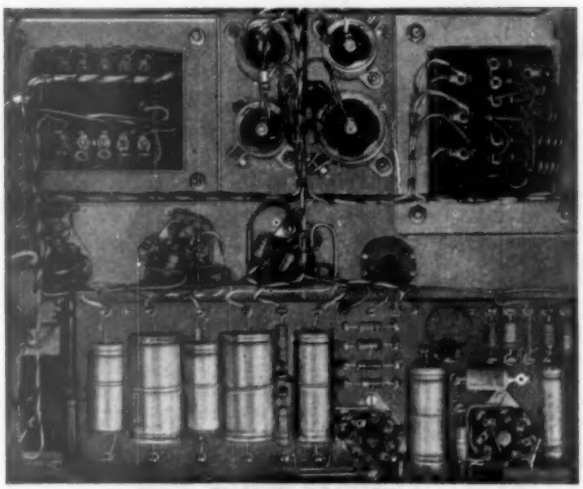


PF91A



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28 GNS

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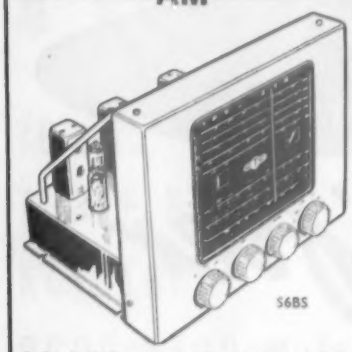

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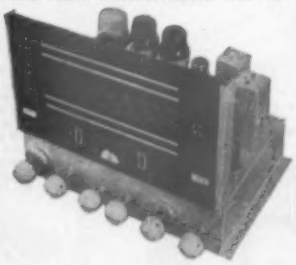

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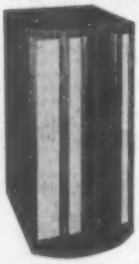

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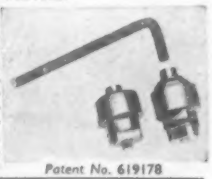

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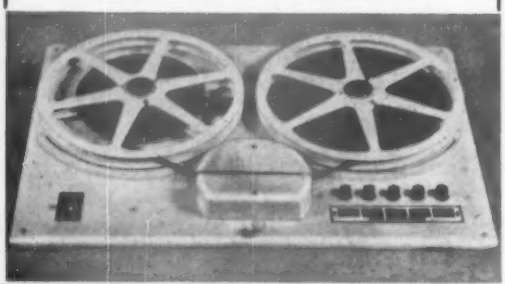

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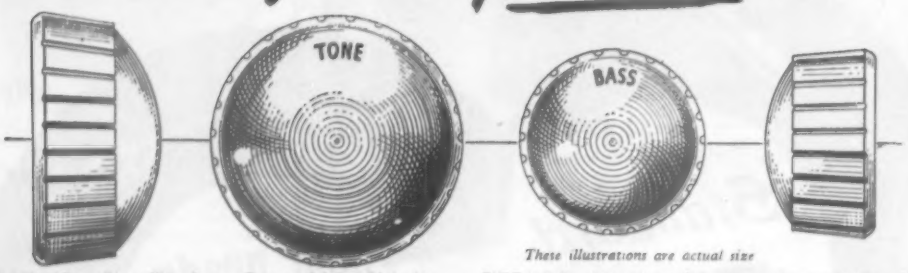

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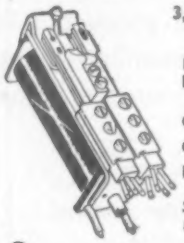

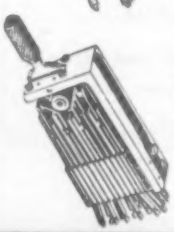

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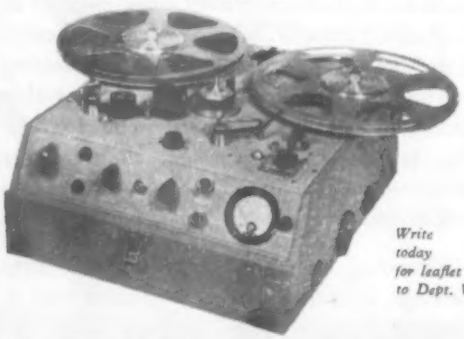

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The aerial is designed for reception of long, medium and short waves, with any ordinary or communications receiver, having an input impedance greater than 1,000 ohms long/medium waves and 150 ohms short waves. The installation discriminates against locally generated electrical interference, especially on the short wavebands. The equipment enables the installation of an 8.3 Mcs flativ-tuned dipole which operates as a "T" aerial on medium and long waves. The aerial and receiver transformers are intended to be interconnected with a 70 ohms co-axial cable.

COMPONENT PARTS

Aluminium Aerial Transformer Assembly. Comprising one each: Aluminium transformer, Transformer clip rubber sucker, ¼in. × ¼in. brass screw, 4BA × ¼in. brass bolt, 4BA nut.
Receiver Transformer. Complete with insulators, clips, etc.; porcelain insulators, 2 each, 60ft. insulated aerial wire, 60ft. screened co-axial down lead.
Installation instruction leaflet included.
LESS CO-AXIAL CABLE & AERIAL WIRE, 15/-, plus 1/6 pkg. and carr.
COMPLETE, 35/-, plus 1/6 pkg. and carr.

★ **QUALITY CRYSTAL PICK-UP ROTHERMEL TYPE U48 23 -**
Plus 1/6 Pkg. and Carr.

The New
"PREMIER PORTABLE"
TAPE RECORDER

USING THE NEW LANE 2 SPEED TAPE UNIT MARK 6

COMPLETE 39 GNS CASH

Packing & Carriage 1 gn.

(Including Reel of Scotch Boy Tape and Microphone)

or **Complete Kit** including All Parts, Valves, Speaker Cabinet, Tape Unit, Reel of Scotch Boy Tape, Rewind Spool and Microphone at **£37.4.0** plus pkg. & carr. 15/-.

H.P. TERMS

Deposit £10.4.9 and 12 monthly payments of £2.17.7

SPECIFICATION

★ TWO SPEEDS 7½in. AND 3¾in. PER SECOND.
★ THREE SPECIALLY DESIGNED RECORDING MOTORS.
★ 1,200ft. TAPE REELS PROVIDING PLAYING TIMES OF 1 HR. AND 2 HRS.
★ DROP-IN TAPE LOADING.
★ EASY FORWARD OR REWIND WITHOUT REMOVING TAPE.
★ ONE KNOB DECK OPERATION.
★ 7 VALVE HIGH QUALITY AMPLIFIER.
★ INDEPENDENT TREBLE AND BASS CONTROLS.
★ MAGIC EYE RECORD LEVEL INDICATOR.
★ AMPLIFIER MAY BE USED FOR RECORD REPRODUCTION OF HIGH QUALITY.
★ COMPARTMENT FOR HOUSING MICROPHONE.
★ SPECIALLY DESIGNED MICROPHONE BY A LEADING MANUFACTURER.

SEPARATE UNITS CAN BE SUPPLIED AS LISTED BELOW:—

Amplifier (built, wired and tested with Speaker) £14/15/-, plus postage and carriage 7/6.
Hire purchase terms, Deposit £3/13/9 and 12 monthly payments of £1/0/9.
Amplifier Kit (including Speaker). £11/-/- plus packing and carriage 5/-.
Hire purchase terms, Deposit £2/15/- and 12 monthly payments of 15/6.
New Lane 2-speed Tape Unit Mark 6, £18/10/- plus packing and carriage 7/6.
Hire purchase terms. Deposit £4/12/6 and 12 monthly payments of £1/6/-.
Portable Cabinet (rexine covered). £4/19/6, plus postage and carriage 5/-.
Microphone, £2/19/6, plus postage and carriage 1/-.
Reel Scotch Boy Tape MC2-111 (1,200ft.). £1/15/-, plus packing and carriage 1/-.
Instruction Booklet, 2/6. Post free.

PREMIER RADIO COMPANY

WILLIAMSON AMPLIFIER KIT 15 gns.
plus 7/6 p. & p.

H.P. Terms Dep. £5.5.0 & 12 m'thly p'ym'nts of 19/9
This Kit is absolutely complete and all components are guaranteed exactly to author's specification.

WILLIAMSON OUTPUT TRANSFORMER
Author's Specification 3.6 ohms secondaries **£4.4.3**

MAINS TRANSFORMER SP425A (Completely Shrouded)
This Transformer has an additional 6.3v, 2A and is capable of supplying an extra 50 mA. for Pre-amp or Feeder unit **£2.12.6**

WILLIAMSON CHOKES
12H 150 mA. Fully shrouded **19/6**
30H 20 mA. Fully shrouded **11/9**

METERS

Full Scale Deflection	External Dimensions in.	Movement	
2.5 A.	2½ × 2½	R.F. Thermo ..	7/6
20 A.	2½ round	M/C	8/6
40 A.	2½ round	M/C	8/6
5 mA.....	3½ round	.....	7/6
500mA. ..	2½ round	M/C	10/6
30 A.	2½ × 2½	M/C	8/6
50 mA.....	2½ × 2½	M/C	7/6
20 V.	2½ × 2½	M/C	6/6
40 V.	2½ × 2½	M/C	8/6
1 mA.....	2 × 2	M/C	17/6
1 mA.....	2½ round	M/C	22/6
1 mA.....	2½ round	Desk type M/C	25/-

H.T. ELIMINATOR AND TRICKLE CHARGER KIT
All parts to construct an eliminator to give an output of 120 volts at 20 mA., and 2 volts to charge an accumulator. Uses metal rectifier, 37/6.

GARRARD GRAMOPHONE UNITS
£4 · 19 · 6
plus 5/- p.c.

Induction motor 100-250 volt, 50 cycles A.C. only. 78 r.p.m. The GARRARD Induction motor is totally enclosed. Entirely free from radio frequency disturbance, magnetic hum and electrostatic. Variable speed. With 12in. Turntable. BRAND NEW!

CORRECT ASPECT WHITE Rubber Mask—Round or Flat
6in. ..... 8/6 10in. 22/6
12in. 12/11

T.V. PRE-AMPLIFIER
Amplifier Unit Type 208A using 2-VR91 valves suitable for operation on London frequency. Brand New. Plus 1/6 pkg. and carr. **19/6**

Build these NEW PREMIER DESIGNS

3-BAND SUPERHET RECEIVER

MAY BE BUILT FOR **£7.19.6** Plus 2/6 Pk. & Carr.

Latest type Superhet Circuit using 4 valves and metal rectifiers for operation on 200/250 volts A.C. mains. Waveband coverage—short 16-50 metres, medium 180-550 metres, and long 900-2000 metrs. Valve line-up 6K8 freq. changer 6K7 IF. 6Q7 Detector AVC and first AF 6V6 output. The attractive cabinet to house the Receiver size 12in. long, 6¼in. high, 5¼in. deep can be supplied in either WALNUT or IVORY BAKELITE or WOOD. Instruction Book 1/- post free which includes assembly and wiring diagrams, also a detailed stock list of priced components.

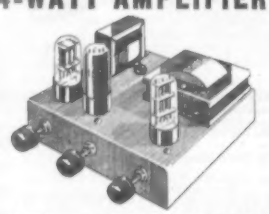
TRF RECEIVER

MAY BE BUILT FOR **£5.15.0** Plus 2/6 Pkg. & Carr.

The circuit is the latest type TRF using 3 valves and Metal Rectifiers for operation on 200/250 A.C. mains. Wave band coverage is 18-55 metres on medium wave and 800-2,000 metres on long wave. The dial is illuminated and the Valve line-up is 6K7 H.F. Pentode 617 Detector and 6V6—Output. The attractive Cabinets to house the Receiver size 12in. long, 6¼in. high, 5¼in deep, can be supplied in either WALNUT or IVORY BAKELITE or WOOD.

INSTRUCTION BOOK 1/- (post free) which includes Assembly and wiring diagrams, also a detailed Stock List of priced components

4-WATT AMPLIFIER



MAY BE BUILT FOR **£4.10.0** Plus 2/6 Pk. & Carr.

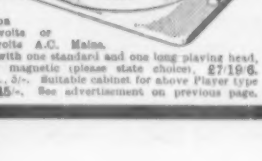
Valve line-up 6SL7, 6V6 and 6X5, FOR A.C. MAINS 200/250 VOLTS. The twin triode 6SL7 is used for preampli fication and also for a comprehensive tone control circuit, which includes two very wide range and continuously variable tone controls for bass and treble. The output Valve is of the beam type and feeds 4 watts into a specially designed output Transformer which is suitable for either 3 ohm or 15 ohm Speakers. Negative feed-back is applied from the secondary of the output Transformer over the whole Amplifier to the input stage giving an excellent frequency response. Due to the high gain and wide range tone controls any type of pick-up may be used. Overall size 9 × 7 × 5in. Price of Amplifier complete, tested and ready for use, £5/5/-, plus 3/6 pkg. and carr.

INSTRUCTION BOOK, 1/- (Post Free) which includes Assembly and wiring diagram, also a detailed Stock List of priced components.

DECCA MODEL 33A
DUAL SPEED RECORD PLAYER

Includes crystal pick-up with sapphire stylus and a light-weight plastic spring balanced arm. Heavy gauge pressed steel case with brown enamel finish in good quality for operation on A.C. mains 200/250 v. 50 c.p.s. Supplied complete with single head (either standard or long playing). **4 19.6** Extra Head can be supplied. Plus pkg. and carr. 5/-.

B.S.R. Type GU4A 3-SPEED GRAM UNIT
Fitted with Decca Heads



Single Record Player, 3-speeds 33½, 45 and 78 r.p.m. for operation on 100-120 volts or 200-230 volts A.C. Mains. Complete with one standard and one long playing head, crystal or magnetic (please state choice), £7/19/6. pp. & carr., 5/-. Suitable cabinet for above Player type PC/2 at 45/-. See advertisement on previous page.

MINIATURE TUNING CONDENSERS
2-gang .0005 mfd. with trimmers 6/9

PREMIER VARIABLE IMPEDANCE "MATCHMAKER" M.O.15 OUTPUT TRANSFORMER
Designed to meet the demand for an efficient variable ratio Output Transformer 11 ratios from 13 : 1 to 80 : 1 all centre tapped and can be used to match any output valves either single or push-pull Class "A" "AB1" "AB2" or "B" to any low impedance speech coil or combination thereof. Primary Inductance 50 henries 15 watts audio 100 mA. Price 45/-.

LOUDSPEAKERS
ELAC—2½in. dia., Moving Coil, 15 ohm imp. .. 15/-
PLESSEY—3in. dia., Moving Coil, 3 ohms imp... 9/11
ELAC—6in. dia., Moving Coil, 3 ohms imp..... 19/6
PLESSEY—6in. dia., Mains Energised, 3 ohms imp. (600 ohms field) with Pentode Transformer 22/6
PLESSEY—8in. dia., Mains Energised, 3 ohms imp. (600 ohms field) 19/6
PLESSEY—10in. dia. Moving Coil, 3 ohms imp... 23/6
GOODMANS—12in. dia., Moving Coil, 15 ohms. Plus 5/- packing and carriage £3 12/6
VITAVOX—K12/20 12in. dia., Moving Coil, 15 ohms. imp. £11/11
Plus 5/- packing and carriage.

CRYSTAL MICROPHONE INSERTS
Ideal for tape recording and amplifiers. No Matching transformer required, 8/6 post free.

ACCUMULATORS
2 volt 10 amp. (by famous maker) 4/11
2 volt 16 amp. 5/11

MOVING COIL METER
A super quality Moving Coil Meter basic movement 2 mA. and 4 mA. Scale dimensions 2½in. dia. 1¼in. deep. Bakelite Case projecting type. At present scaled 1 amp. R.F. By removing thermo couple, reversing scale and recalibrating the meter, a high grade test instrument with any range above the basic F.S.D. may be built up. Price 2 mA., 5/9. 4 mA., 4/9.

MICROPHONES
LUSTRAPHONE: Moving Coil; High Impedance, Stand Type **£5/15/6**—Hand Mike **£6/6/-**.
ROSETTE—Crystal Mike Incorp. the Filter Cell Insert: High Impd. Ball Type, **£2/10/0.**
CRYSTAL MICROPHONE—Rothermel 2AD56. Especially recommended. **£2/15 0. Table stands for all the above 10/6 and 17/6.**
ACOS. High impedance Crystal Microphone, type 35-1, 25/-.
ACOS. High Impedance Crystal Microphone, type 33-1, £2/10/-.
ACOS. "MIC 30" impedance Crystal Microphone **£2/10/-.** (This Microphone can be used as either Hand or Desk type.)

CRYSTAL MICROPHONE
An entirely insulated crystal microphone which can be safely used on A.C./D.C. amplifiers. High impedance. No background noise, really natural tone. The ideal Mike for tape, wire and sound projectors, price **19/6.**

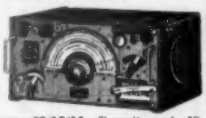
MAINS NOISE ELIMINATOR KIT
Two specially designed chokes with three smoothing condensers with circuit diagrams. Cuts out all mains noise. Can be assembled inside existing receiver, **4/11.** plus 6d. pkg. and carr.

Germanium Crystal Diodes. G.E.C. wire ended, **2/6.** 24/- doz.

PREMIER RADIO COMPANY

1155 RECEIVER UNIT

BRAND NEW



In original cases complete with 10 valves. Frequency range 18.5 Mc/s.-75 Kc/s. in 5 wavebands. **£11/19/6.** Plus 10/6 packing and carriage.
Hire Purchase Terms: **£2/19/11** Deposit and 12 monthly payments of **16/10d.**

POWER SUPPLY UNIT

for above, incorporating output stage. Supplies an output of 250 volts at 80 mA. which is ample for the R1155 with the output stage. Jones plugs for connecting the Power Pack to the Receiver are included. The 6V6 output stage complete with Output Transformer and 6in. speaker is built into the unit. Price **£5/5/-**, plus 5/- packing and carriage.
The two above Units together on Hire Purchase Terms: **£4/6/2** Deposit and 12 monthly payments of **£1/4/2.**

PUSH-PULL OUTPUT TRANSFORMERS. 2 x 6V6 into 2/3 ohms., **5/6**, post free.

T.1154. BRAND NEW COMPLETE WITH VALVES. £3/19/6, post and carriage 1/6.

METER RECTIFIERS. Miniature type with leads 1-5 mA., **6/9**, post paid.

AMPLIFIER TYPE A1134A. Battery operated 2 valves, type VR.21 and VR.35, **9/11**, postage and carriage 1/6.

SLIDER RESISTANCE. Geared adjustment, 7.5 ohms. 4 a., **12/6**, postage and carriage 1/6.

HEAVY DUTY POWER RESISTANCE. 17.5 ohms. 8 a., with adjustable tapping 19in. long, 2½in. diameter, **10/-**, postage and carriage 2/-.

HEAVY DUTY L.T. TRANSFORMER. Primary tapped 180-230 volts, 50 cycles. Secondaries 4.2 v. 10 a. 4.2 v. 10 a., **25/-**, postage and carriage 2/6.

ROTARY RESISTANCE. Wire wound heavy duty 14 k. ohms., **7/6**, postage and carriage 1/-.

VACUUM PUMPS. For model makers etc. Ex-R.A.F. Type 83-Mk. III. **22/6**, postage and carriage 2/-.

SPECIAL OFFER

5-VALVE SUPERHET RADIO RECEIVER

PRICE

£10.19.6

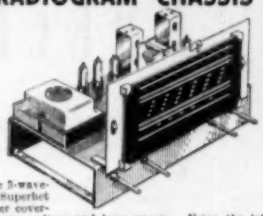
Pkg. & Car. 10/-

In highly polished walnut cabinet. Built to high standards ensuring quality reception. Specifications:

VALVE LINE-UP: 7S7, 7B7, 7C6, 7C5, 7V4. 2 WAVEBANDS, Long, Medium and Short. CONTROLS Tuning, wave change, volume tone control on/off Gram Position on Switch. Pick-up and Extension Speaker Sockets incorporated. For use on 200/250 v. A.C. mains. DIMENSIONS: Width, 16½in., Height 13½in., depth 8½in.

H.P. Terms: **£2/14/11** deposit, and 12 monthly payments of **15/6.**

RADIOGRAM CHASSIS



5 Valve 3-waveband Superhet Receiver covering short, medium and long waves. Using the latest miniature all glass valves, overall chassis size 13½in. x 7in. high x 6in. deep, dial aperture 10in. x 4½in. BRAND NEW, READY FOR USE AND GUARANTEED. **£10-5-0**
Packing and postage 10/-.
Or on Hire Purchase Terms, deposit **£2/11/3** and 12 monthly payments of **14/5.**

CABINET available for above Chassis in figured walnut, lined with white sycamore, size 3ft. wide, 2ft. 8 inches high, 1ft. 5 inches deep. **£15/15/-.**
Or on Hire Purchase terms, deposit **£3/18/9** and 12 monthly payments of **£1/2/9.**
Packing and Carriage extra.

COMPONENTS AVAILABLE FOR THE MULLARD AND OSRAM DESIGNS

WE have been established over 40 years and we have advertised in the Wireless World continuously for the greater part of this period. Over the years we have given satisfaction to thousands of customers and our aim is to continue the good service for which we have become famous. Our advice is always available both before and AFTER Sale. **All components supplied for our Radio and T.V. Designs are guaranteed for a period of 12 months (Valves carry the usual Maker's 3 months' guarantee).**

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The Annual Review of the World's Photographic Art

PHOTOGRAMS OF THE YEAR is the finest review of pictorial art obtainable, and makes an ideal gift. Now greatly enlarged, it measures 10¾in. × 8¼in., with many extra pages of plates, some in full colour. The reproductions, in high-quality photogravure, are gathered from the world's leading salons. A critical plate-by-plate commentary and articles on the year's work, colour photography, etc., will be of outstanding interest to all photographic enthusiasts.

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This book enables the beginner to learn to make photographs of real merit, and is a valuable reference book for the more advanced photographer. It explains exactly what happens in the photographic process at all stages—from selecting the subject to the finished print. Written by one of Europe's leading experts, the book is illustrated with 262 photographs, 28 diagrams and 8 pages of colour plates.

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8½in. x 6in.
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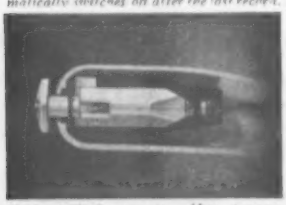
ILIFFE & SONS LTD., DORSET HOUSE, STAMFORD STREET, LONDON, S.E.1.

PRECISION ENGINEERING

for armchair Entertainment...

MAGIDISK Selector. *Silent transparent plastic trigger mechanism of featherlight operation effecting smooth automatic selection of 7in., 10in. or 12in. records, mixed in any order. Foolproof automatic lever system.*

ROTOCAM combined Switch and Speed Control. *Concentric plastic knobs working simple connecting rods and slide presetting 33⅓, 45 or 78 r.p.m. speeds. Gives centralised control. Automatically switches off after the last record.*



PICK-UP Assembly. *High Fidelity lightweight crystal pick-up head and well-balanced arm. Easily adjusted for height and weight. Fitted with dual precision ground sapphire styli for 78 r.p.m. and microgroove recordings.*

TO make the Monarch autochanger the automatic choice of record lovers, gramophone experts and reproduction equipment makers alike, has meant consistent precision engineering in every department of its construction. Each feature is the acme of inventiveness and skilled production.

The Magidisk, which noiselessly selects any 10 records of any size or playing speed, is perhaps the most important and exclusive attribute. Simplified switching and speed control is achieved by a combination which does both jobs at once. Then there is the lightweight pick-up assembly with crystal cartridge and replaceable dual sapphire styli.

The ever-improving high quality reproduction obtained by the Monarch is the result of testing and modernising these and other special components continually. It provides a longer, more faithfully interpreted and less interrupted programme. It ensures a long, reliable and "pleasureful" record-playing life.

MONARCH

AUTOMATIC RECORD CHANGER

BIRMINGHAM SOUND REPRODUCERS LTD., OLD HILL, STAFFS.

BSR

Wireless World

RADIO, ELECTRONICS, TELEVISION

44th YEAR OF PUBLICATION

Managing Editor: HUGH S. POCOCK, M.I.E.E.
Editor: H. F. SMITH

DECEMBER 1954

In This Issue

EDITORIAL COMMENT 581
TELEVISION INTERMEDIATE FREQUENCIES 582
WORLD OF WIRELESS 584
LEGAL REPORTING. By *T. D. Conway* 588
VELOCITY OF RADIO WAVES. By *R. L. Smith-Rose* .. 590
TELEVISION SAFETY PRECAUTIONS. By *E. G. Goodhew* .. 591
LETTERS TO THE EDITOR 593
TIN-ZINC PLATING 595
EXTENDED-RANGE L.F. SINE WAVE OSCILLATOR. By *L. F. Sinfield* 596
PAN-CLIMATIC TESTING. By *G. W. A. Dummer, S. C. Schuler and J. E. Green* 598
FESTIVAL OF SOUND 601
FILTERS WITHOUT FEARS—4. By *Thomas Roddam* .. 603
COLOUR COMPLICATIONS 608
FEEDBACK I.F. AMPLIFIERS FOR TELEVISION. By *H. S. Jewitt* 609
MEDIUM POWER TELEVISION TRANSMITTER 611
SIGNAL-OPERATED SWITCHING. By *R. Selby* 613
PITH BALLS AND GRID CURRENT. By "*Cathode Ray*" 616
SHORT-WAVE CONDITIONS 620
FLYWHEEL SYNCHRONIZING—3. By *W. T. Cocking* .. 621
MUST WE HAVE COMPATIBILITY? 625
INTERNATIONAL RADIO RESEARCH 626
DECEMBER MEETINGS 627
RANDOM RADIATIONS. By "*Diallist*" 628
UNBIASED. By "*Free Grid*" 630

PUBLISHED MONTHLY (last Monday of preceding month) by ILIFFE & SONS LTD., Dorset House Stamford Street, London, S.E.1. *Telephone:* Waterloo 3333 (60 lines). *Telegrams:* "Ethaworld, Sedist, London." *Annual Subscription:* Home and Overseas, £1 7s. 0d. U.S.A. $4.50. Canada $4.00. BRANCH OFFICES: *Birmingham:* King Edward House, New Street, 2. *Coventry:* 8-10, Corporation Street. *Glasgow:* 26B, Renfield Street, C.2. *Manchester:* 260, Deansgate, 3.

VALVES, TUBES & CIRCUITS

24. THE MULLARD EM80 TUNING INDICATOR

The Mullard range of tuning indicators has been augmented by a B9A (noval-based) type, the EM80. This valve has a 6.3V, 300mA heater, and it is designed for operation at an h.t. voltage of 250V. The maximum overall dimensions are 67mm. by 22.2mm; and the display area, which is viewed through the side of the bulb, is approximately 14.5mm. wide and 19mm. high. The lower edge of the area is 24.0± 1.5mm. above the seating of the valve.

The indicator pattern consists of three curved green 'petals' radiating from the centre of the lower edge of the fluorescent screen or target (t). The width of the petals is determined by the voltage of two linked deflectors which are mounted in an accelerated electron stream. The deflector voltage is derived from the anode of a triode whose grid is connected to the AGC line of the receiver. As the AGC voltage becomes more negative, the deflector voltage rises and the petal width is increased, indicating correct tuning.

A common cathode serves the indicator system and the amplifying triode, but the triode is mounted below the cathode in order to avoid unwanted interaction with the indicator. A transparent but electrically conductive coating on the inner surface of the bulb prevents wall charge and secondary emission effects.

The triode has been designed to produce a clear indication at all usable signal levels, corresponding to an AGC voltage range of −1V to −16V; and the sensitivity is sufficient to indicate degrees of detuning which are not detectable by ear. In a normal receiver, detuning by a certain number of cycles per second causes larger AGC voltage variation at large input signals than at small; therefore a tuning indicator tends to be more sensitive to detuning at low signal levels. Thus in earlier types, separate indicator systems were used for large and small signals. In the EM80, however, alternative indications have been combined in a single system. Use has been made of the fact that the listener will automatically watch the part of the indicator display which is changing its relative area most rapidly. At low signal levels the area of the *petals* shows the most marked rate of change; but with stronger signals the *shadow* areas are relatively small, and their enhanced rate of change with AGC voltage attracts the listener's attention.

The EM80 is suitable for use in a.c. mains-operated AM receivers. It will also give a reliable indication of the correct tuning point in FM receivers where the bandpass response is slightly peaked.

PRELIMINARY DATA

HEATER

V_h	6.3	V
I_h	0.3	A

OPERATING CONDITIONS

V_b	250		V
V_t	250		V
R_a	470		kΩ
R_{g-k}	3		MΩ
I_a (V_g=0)	2		mA
V_g	−1	−16	V
β (approx.)	5	50	degrees
I_a	0.4	0.01	mA

LIMITING VALUES

V_a max.	300	V
p_a max.	0.2	W
V_t max.	300	V
V_t min.	165	V
I_k max.	3	mA
V_{h-k} max.	100	V

BASE B9A

1	2	3	4	5	6	7	8	9
g	k	IC	h	h	IC	a	IC	t

Reprints of this advertisement, with additional notes and characteristic curves, are obtainable without charge from the address below.

MULLARD LTD., Technical Service Department, Century House, Shaftesbury Avenue, W.C.2

MVM.309

Wireless World

DECEMBER 1954 VOL. 60 No. 12

The Licence Muddle

UNTIL recently the all-powerful Post Office control of radio has not come under serious or widespread criticism. With a few minor exceptions, the ruling of our activities has been beneficent, and progress has been helped rather than hindered by exercise of the sweeping powers enjoyed by the Postmaster-General. But now there is growing support for the idea that some at least of these powers should be transferred to other hands.

To understand the monopolistic nature of the Government's control of radio, we have to go back about 100 years, when Benjamin Disraeli "nationalized" (as we should now say) the electric telegraph by making it a monopoly of the Post Office. Wired telephony and then wireless telegraphy and wireless telephony were successively added to that monopoly by subsequent legislation. Finally, by the Act of 1949, the P.M.G. was virtually given control of all "radiation of electromagnetic energy of a frequency not exceeding three hundred million megacycles a second"— and not only for purposes of communication. That sounds wide enough!

Growing resentment against the monopoly has been brought to a head by a recent test case in the High Court, started by the firm of Davey Paxman, who are members of the Mobile Radio Users' Association. The Post Office agreed to refund the charges collected from the firm for licences; these had been levied without proper authority, as the P.M.G. had failed to make the necessary regulation. The firm did not press another (and perhaps more interesting) part of their suit for a declaration that the Post Office had no right to impose conditions in the licence regarding change of frequencies.

The Mobile Radio Users' Association said, in a statement issued after the test case, that it was brought to focus attention on the "unsatisfactory administration" of mobile radio services. In particular, they stressed that certain channels allocated exclusively to land mobile radio are now to be transferred to commercial television. Members of M.R.U.A. are thus put to inconvenience and expense, and suitable alternative channels have not been made available. M.R.U.A. is pressing for compensation, security of tenure and adequate spectrum space. They contend the new regulations contain "preposterous anomalies" and express the view that there is in this country no satisfactory machinery for resolving frequency allocation problems.

Others beside M.R.U.A. are dissatisfied with recent Post Office actions. We recently drew attention to the foolishly conceived hotels broadcasting licence, which seems virtually to have become a dead letter almost as soon as it was framed. Then there is the muddle over the air-sea rescue device SARAH, which was apparently given a channel in Band III after it had been decided to clear that band for commercial television.

Perhaps the most serious shortcoming of the Post Office is the failure to implement that part of the Wireless Telegraphy Act, 1949, which gives power to make regulations for curbing interference. The Act was passed five years ago, but, so far, all that has been done is to control interference from petrol engines. In the meanwhile, the manufacture of electrical devices capable of causing trouble is increasing at a frightening rate, and nothing can be done about it except to invoke the maker's goodwill. For example, a 100-kW r.f. heater, radiating at any frequency the maker chooses, may be legally operated next-door to an important receiving station or, more realistically, in the middle of a densely populated area that does not happen to enjoy a strong television signal.

It has been said from time to time that the Post Office is basically unsuited to the task of controlling radio because, being itself a user of that medium of communication, it is in competition (especially in the matter of channel allocation) with its own licensees. That argument now applies with even greater force, in view of the growing demands of conflicting interests. But nowadays the vital factor is that broadcasting—especially television—has unfortunately become one of the most controversial of political issues. Under the present system the impartiality that is so essential in a controlling body cannot easily be maintained.

Television Intermediate Frequencies

B.R.E.M.A. RECOMMENDATION

THE British Radio Equipment Manufacturers' Association has recently recommended that a frequency of 34.65 Mc/s be adopted for the vision intermediate frequency in television receivers. The recommendation has been made with the aim of minimizing not only any interference to which a television receiver may itself be subject but also any which a television receiver may cause to other receivers. It comes after a lengthy investigation into the technical problems involved.

In the past, the choice of intermediate frequency has been made chiefly with a view to avoiding i.f. harmonic interference. The advent of Band III, however, now makes it impossible to avoid it in this way; all that can be done is to choose the frequency to minimize it and to avoid the possibility of low-order harmonics being involved. In the future, the main remedy for it must lie in proper screening.

The major object in the choice of frequency to-day is so to place it that neither the intermediate frequency itself nor the second-channel and kindred frequencies, which are influenced by it, fall in places where strong signals from other stations are likely in residential areas. Also, so that the local oscillator of the television set will not interfere with other nearby receivers, whether television or not.

Choice of frequency and the liability to interference depend very much on whether the local oscillator is higher or lower in frequency than the incoming signal. The lower beat has often been chosen in the past, mainly because it is easier to obtain good oscillator stability. Interference problems are considerably more severe with it, however, and so the use of the higher frequency is recommended.

With this frequency, the main interference possibilities are as shown on the chart. From this, it is at once evident that the best choice is around 35 Mc/s. The precise figure of 34.65 Mc/s is selected to minimize i.f. harmonic feedback on Band III; the fifth harmonic then falls midway between channels 8 and 9 and only on channel 12 is there likely to be any trouble. If there is, it is from a sixth harmonic which is likely to be relatively weak.

With the oscillator above the signal, the sound i.f. falls 3.5 Mc/s higher than the vision i.f.—at 38.15 Mc/s. This is not very far from the sound signal of channel 1, 41.5 Mc/s, and any appreciably higher intermediate frequency would clearly be impracticable. The sound i.f. is not so well placed as the vision in regard to interference, but it is not so important because, with its much narrower bandwidth, interference is more readily avoided by a slight change of tuning.

Amateur transmitters can be a major source of interference because they are commonly operated in residential areas. The 34.65-Mc/s frequency should result in the disappearance of such interference, since it avoids the amateur bands, both for the i.f. itself and for the second-channel.

Oscillator radiation is just as troublesome as the other forms of interference, but to others than the owner of the set concerned. Viewers in the Brighton area have known this for some time, since the oscillators of some older sets tuned to channel 1 fall in channel 3. It is impracticable completely to suppress oscillator radiation and all that can be done is to put it where it will do least harm. With the 34.65-Mc/s

Interference level		
1	Amateur transmitters	Direct breakthrough 144–146 Mc/s amateur band in 2nd channel of Band I Direct breakthrough second harmonic 21.0–21.45 Mc/s
2	Fundamental oscillator radiation in television bands from other television receivers	Oscillator in Band I Oscillator in Band III
3	2nd channel interference due to transmitters in Bands I, II and III	Band II in 2nd channel of Band I receiver Band I in 2nd channel of Band I receiver Band III in 2nd channel of Band III receiver
4	Fixed and Land Mobile in 2nd channel of Band I receiver	Interfering signal in Band 71.5–72.8 Mc/s Band 76.7–78.0 Mc/s Band 80.0–84.0 Mc/s Band 85.0–88.0 Mc/s Band 95.0–100 Mc/s Band 146–168 Mc/s
5	Direct breakthrough due to I.S.M.	Interfering signal 13.56 Mc/s 27.12 Mc/s 40.68 Mc/s
6	Second harmonic of i.f. sound and vision carriers appearing in r.f. pass-band of receiver	
7	Direct breakthrough of International Broadcast Bands	Interfering signal in Band 11.7–11.975 Mc/s Band 15.1–15.45 Mc/s Band 17.7–17.9 Mc/s Band 21.45–21.75 Mc/s Band 25.6–26.1 Mc/s
8	Direct breakthrough of S.B.A. beacons	Interfering signal in Band 31.7–34.5 Mc/s Band 36.5–39.0 Mc/s
	Television oscillator radiation from Band I receivers interfering with other services	Interfering with Band II Interfering with Fixed and Land Mobile Band 71.5–72.8 Mc/s Band 76.7–78.0 Mc/s Band 80.0–84.0 Mc/s Band 85.0–88.0 Mc/s Band 95.0–100.0 Mc/s

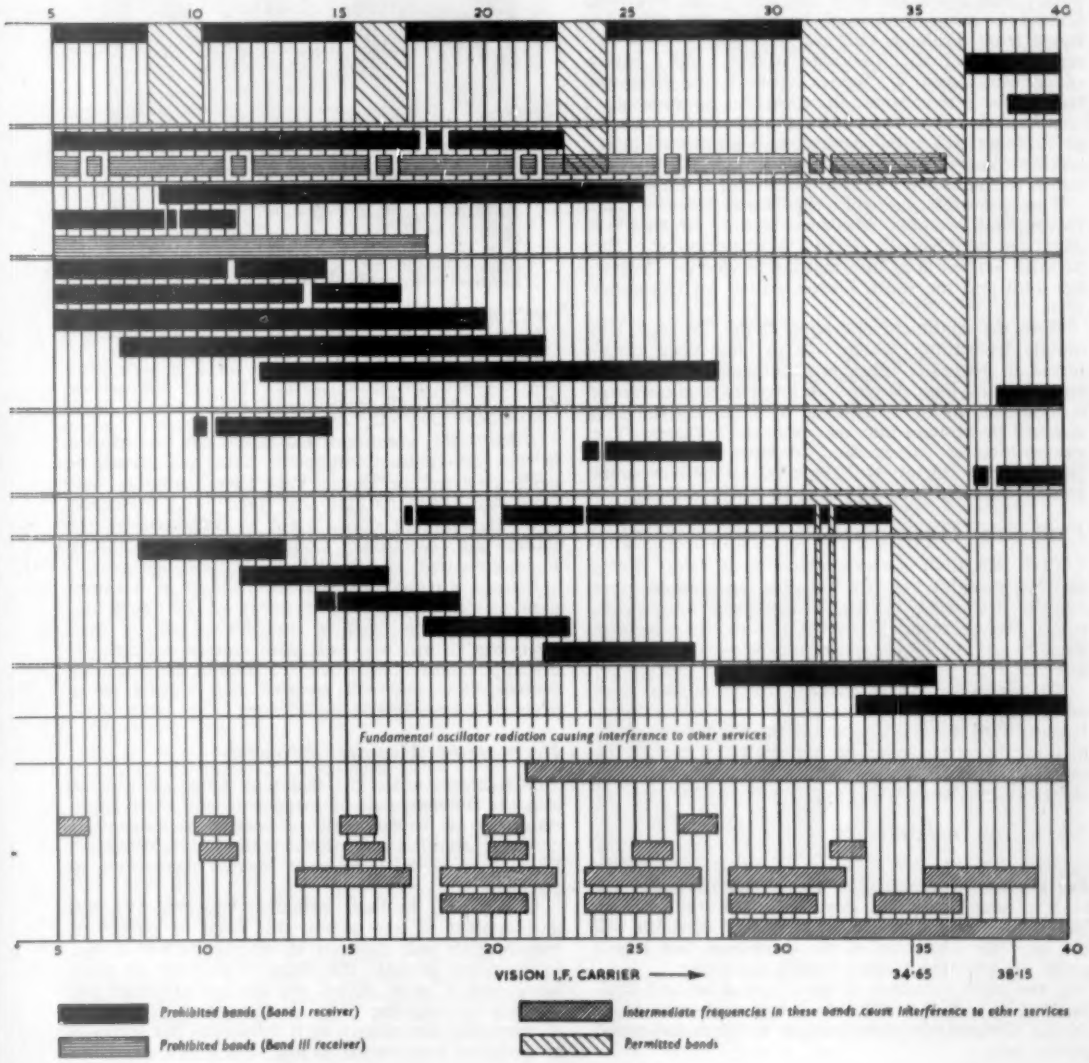
Chart showing the forms of interference that are possible with various intermediate frequencies, the local oscillator being above the signal frequency.

i.f., any oscillator radiation will affect broadcasting mainly in Band II but, although the chart does not show it, there are distinct possibilities of avoiding it by a suitable allocation of the television and f.m. frequencies on an area basis. This would mean so allocating frequencies that in any area the oscillators of Band I television receivers did not fall on the Band II frequencies used for that same area.

Generally speaking, nearly everything is in favour of a high intermediate frequency. The only important drawback is that it makes it rather more difficult to obtain adequate adjacent-channel selectivity. That adequate selectivity can be obtained is evidenced, however, by the fact that some firms have successfully used frequencies quite near to 34.65 Mc/s for some years; and, of course, the older straight sets worked at a still higher frequency.

The frequency of 34.65 Mc/s is not a critical one. In selecting it, allowance has been made for the inevitable drift of the local oscillator and for variations from the nominal intermediate frequency. The last are small in new sets, since precision equipment can be used in the factory. Signal generators employed by dealers, however, may not be more accurate than 1 per cent in frequency, so that when a set is realigned its i.f. may depart from the nominal value by this amount. The allowance for all causes of drift has been taken as ± 500 kc/s.

The use of the 34.65-Mc/s frequency will not, in itself, necessarily remedy interference in particular cases. The full benefit will be obtained only when all manufacturers adopt it and, even then, not until existing sets with other frequencies have fallen into disuse. Its use should, in time, reduce much of the existing interference and should certainly prevent chaotic conditions from arising in the future.



WORLD OF WIRELESS

More TV Stations

◆

Interfering Receivers

◆

Components & Instruments Shows

Extending TV Coverage

IT WAS originally planned to close down the temporary transmitter on Truleigh Hill, near Brighton, when the Rowridge, Isle of Wight, transmitter was brought into service on November 12th. The temporary mast at the Isle of Wight station has, however, limited the range so some of those who were getting a signal from Truleigh Hill are at present outside the service area of the Rowridge station. As a result of pressure from W. Sussex viewers, the Brighton transmitter is to continue in service for the present.

It has, of course, been necessary for the frequencies of Truleigh Hill to be changed to avoid mutual interference, and it is now operating in Channel 2, which it shares with Holme Moss and S. Devon.

Test transmissions from the North Hessary Tor, Devon, and Redmoss, Aberdeen, stations began a few days ago in channels 2 and 4 respectively. The Scottish station goes into regular service on December 14th and the south Devon station on December 17th.

With the continued operation of the Truleigh Hill mobile transmitter which was to have been transferred to Norwich, other arrangements have had to be made for East Anglia. A low-power transmitter is, however, to be installed in a temporary building and will be brought into service next February. The site will be at Tacolneston, 10 miles south-west of Norwich, but the city will come within the temporary station's service area (approx. 10 miles radius).

P.M.G.'s Powers

THE RECENT correspondence in *Wireless World* and last month's note by "Diallist" prompted us to enquire if the P.M.G. has, in fact, used his powers, under clauses 6 and 7 in the sound and television licences, to prohibit the use of receivers causing interference.

We understand that there have been two cases where the owners of sound receivers causing interference were notified that unless their sets were modified the licences would be withdrawn. One of the owners refused to modify his set and his licence was, therefore, withdrawn.

Scientific Instruments

THE annual exhibition of scientific instruments and apparatus, organized by the Physical Society, will be held next year in the Royal Horticultural Society's New Hall, London, S.W.1. The change of venue will not alter the character of the exhibition, but it will make the 140 stands more readily accessible.

Fortunately the dates of the Physical Society exhibition (April 25th to 28th) will not clash with those of the components show as has so often happened in the past.

PICTURESQUE setting for the television aerial erected by Pye for the 625-line demonstration transmissions radiated during the recent British Trade Fair in Baghdad

Components Show

A RECORD number of 142 stands will be included in the 12th Radio Components Show which will be held in Grosvenor House, Park Lane, London, W.1, from April 19th to 21st next year. As in former years this private show, which is organized by the Radio and Electronic Component Manufacturers' Federation, will also include valves and test gear.

Instead of circulating admission tickets, as has been done in the past, application cards will be issued and will have to be filled in and forwarded by each intending visitor, who will then receive a ticket "if his application is approved." Prospective overseas visitors, however, will receive their tickets as in previous years without application.

Permanent Magnet Research

TO accommodate the widening front of research into the fundamentals of magnetism and their application in the manufacture of permanent magnets, a new extension has been added to the Central Research Laboratory of the Permanent Magnet Association in Sheffield.

In addition to their principal concern with the development of new alloys, this team of physicists, metallurgists and chemists is, amongst other things, investigating in detail the effects of ambient temperature, over a wide range, on the performance and stability of magnets. The low-temperature range is of particular importance as it influences the accuracy of electrical instruments in high-flying aircraft.

Radio Engineers' Training

DESPITE a deplorably low percentage of success in the graduateship examination of the Brit.I.R.E., the membership of the Institution continues to increase, and at the end of March was 4,750.

Stress is laid in the annual report of the Institution on education and training, especially in relation to the low percentage of passes in the graduateship exam. Of last year's 1,149 candidates, which was a 10 per cent increase on the 1952 figure, only 72 were successful in the entire examination (approximately 6 per cent). The Institution's education committee has, therefore, recommended that a regulation be introduced requiring candidates entering for the examination to provide evidence of supervised practical work.

SIR PHILIP CLARKE

In his inaugural address, the new president, Rear-Admiral Sir Philip Clarke, laid emphasis on the need for close co-operation between radio engineers in the Services, in industry and in Government departments. He also touched on the menace of over-complexity in electronic equipment and urged the need for constant awareness of the possibilities of "neat solutions and brilliant simplifications."

PERSONALITIES

Brigadier E. J. H. Moppett, M.I.E.E., has been on a two-months' tour of Burma, India and Pakistan on behalf of Pye Telecommunications, Ltd., of which he became a director in 1952. His tour was mainly concerned with the introduction of the Pye transmitter-receiver C12, which is the modern counterpart of the wartime maid-of-all-work No. 19 set. He also spent some time with the radio survey team on the company's contract to supply, in conjunction with Redifon, Ltd., and Etelco, Ltd., a complete telecommunications v.h.f. system for the new 350-mile pipeline being laid by the Sui Gas Transmission Company from Sui to Karachi.

F. C. McLean, C.B.E., B.Sc., M.I.E.E., deputy chief engineer of the B.B.C., has gone to Karachi for five weeks to advise the Pakistan government on the development of the country's broadcasting service. The request for assistance in assessing the needs, and the ways in which they can best be met, was made to the British Government under the technical co-operation scheme of the Colombo Plan.

Martin Ryle, F.R.S., M.A., lecturer in physics at the Cavendish Laboratory, Cambridge, is to receive the Hughes Medal of the Royal Society "for his distinguished and original experimental researches in radio astronomy" at the anniversary meeting of the society on November 30th. Martin Ryle left Oxford in 1939 with an M.A. degree and joined T.R.E., where he worked on radar applications until the end of the war. He then went to Cambridge, where he is undertaking radio astronomical research.

R. J. H. Branthwaite, B.A., A.M.I.E.E., formerly chief engineer of Furzehill Laboratories, Ltd., has been appointed by R. B. Pullin & Company, Ltd., of Great West Road, Brentford, Middx, as superintendent of the new electronic division of their Development Laboratories.

H. M. Dowsett, M.I.E.E., F.Inst.P., who retired some years ago from the Marconi Company, which he joined in 1899 as assistant to Marconi, has been elected president of the Association of Retired Engineers. The association was formed in 1951 for retired professional engineers living in the neighbourhood of Worthing, Sussex. Mr. Dowsett was editor of the *Marconi Review* from 1928 to 1939 and for the latter four years was also principal of the Marconi School of Wireless Communication.

Dr. E. Duncan-Smith, D.Sc., M.I.E.E., M.Brit.I.R.E., has been appointed United Nations radio adviser for the Middle East and has relinquished his appointment as radio adviser to the Government of Jordan under the United Nations Technical Assistance Administration. He was formerly at the Admiralty Signal Research Establishment for some six years, where he served in the technical secretariat and the Shore Station Division, in which he assisted in planning high-power communication schemes for the Middle and Far East. After resigning from the Royal Naval Scientific Service and before joining U.N.T.A.A., Dr. Duncan-Smith was with Air Service Training, Hamble, and International Aeradio, Ltd., organizing radio technical training.

G. R. Scott-Farnie, general manager of International Aeradio, Ltd., was invited to attend the annual electronics conference of the American Institute of Radio Engineers held in Kansas City in November and to be principal speaker at the banquet. His subject was "Some International Aspects of Radio Engineering," in which he reviewed the problems facing electronic engineers with the growing demands of civil aviation.

F. Livingston Hogg, M.Brit.I.R.E., A.M.I.E.E., director of Livingston Laboratories, Ltd., specialists in electronic instruments for industry, went to America early in November for an extended tour to study developments in the U.S.A.

E. Green, M.Sc., who for many years has been well known in the transmitter engineering world, having joined the Marconi Company in 1913, has retired from the position as head of the Transmitter Advanced Development Group. He is, however, continuing his work for the company as a full-time consultant engineer. From 1919 to 1929 he assisted C. S. Franklin in the development of the Marconi short-wave beam system. In 1929 he was appointed chief of the group concerned with developing high-power short-wave transmitters and was responsible for the development of many of the well-known S.W.B. series of short-wave transmitters. In more recent years, as head of the Transmitter Advanced Development Group, he has been concerned with the development of vision transmitters. Mr. Green is succeeded by **V. J. Cooper,** B.Sc., M.I.E.E., M.Brit.I.R.E., who has been appointed chief engineer (advanced development). The scope of the group, of which Mr.

E. GREEN

V. J. COOPER

Green was in charge, has been enlarged and the organization is now known as Advanced Development. Mr. Cooper joined the company in 1936 and, like his predecessor, has been concerned with the development of transmitters, including those for the Holme Moss television station.

Dr. V. K. Zworykin, the well-known television pioneer and inventor of the iconoscope camera tube, has retired from the vice-presidency of the R.C.A. Laboratories, which he has held since 1947. He is continuing as technical consultant and has been elected honorary vice-president of the parent organization, Radio Corporation of America. Dr. Zworykin, who served in the Russian Signal Corps in the first world war and afterwards became an American citizen, received the degree of Doctor of Philosophy at Pittsburgh University in 1926. He joined R.C.A. in 1930 after working on the research staff of Westinghouse Electric Corporation.

Colin H. Gardner, past president of the Incorporated Practical Radio Engineers, has completed 25 years' service with Mullard, Ltd., where he is concerned with technical/commercial liaison with dealers. **Leonard A. Sawtell,** Comp.Brit.I.R.E., has also recently completed 25 years' service with the company, where he has been commercial manager of the Entertainment Valve Department since 1945.

B. H. Douthwaite, A.M.I.E.E., has joined British Physical Laboratories, of Houseboat Works, Radlett, Herts, as sales manager. During the war he was engaged on radio counter measures as a member of the scientific staff of the General Electric Company and has subsequently had considerable experience as a technical executive in the electrical industry.

H. Priest has joined the car radio sales division of E. K. Cole, Ltd., as technical representative and will be responsible for liaison with car manufacturers and dealers.

Douglas A. Lyons, of the Trix Electrical Company, is on an eight-weeks' tour of North and South America, during which he is meeting Trix distributors.

OBITUARY

A. H. Ginman, for over 15 years president of the Canadian Marconi Company, died in Canada on November 7th at the age of 79. He joined the Marconi Company, Chelmsford, in 1901, where he worked with Marconi himself, and a year later transferred to the American Marconi Company. He also represented the parent company in the Far East and on returning to England became general manager at Chelmsford for two years before going to Canada in 1935. He retired in 1951.

IN BRIEF

The many readers who were unable to obtain tickets for the recent Festival Hall **Sound Reproduction** demonstration by G. A. Briggs (managing director, Wharfedale Wireless)—reported elsewhere in this issue—will be glad to learn that a similar demonstration will be given on Saturday, May 21st, 1955, in the Royal Festival Hall. Details of admission and prices, which, we understand, will have to be increased to cover the costs, will be announced later.

TV By Wire.—Figures quoted at the annual luncheon of the Relay Services Association show that in addition to the million listeners served by the various relay companies throughout the U.K. some 300,000 receive television by wire.

I.S.W.C.—The International Short Wave Club celebrated its 25th anniversary on October 4th. Founded in the United States, the administration was transferred to London during the war, the present secretary being Arthur E. Bear, 100, Adams Gardens Estate, London, S.E.16.

VALVE JUBILEE.—The 50th anniversary of Sir Ambrose Fleming's first valve patent was celebrated on November 16th at University College, London, and by the I.E.E. In 1884 Edison discovered the rectifying properties of a lamp with a sealed-in anode; Fleming's great contribution lay in the practical application of this device to radio-frequency detection. The photograph shows Dr. H. M. Barlow, professor of electrical engineering at University College, with one of the first Fleming diodes.

Comet Investigation.—Strain gauge equipment, specially developed and manufactured for the Royal Aircraft Establishment, Farnborough, by McMichael Radio, was used in the recent technical investigation into the loss of the Comet airliners. This equipment comprises a multi-channel amplifier of high gain and stability and a 2,000-c/s carrier oscillator.

Proc.I.E.E.—Changes in the publications issued by the Institution of Electrical Engineers are being introduced in January. The *Journal* will continue to be issued monthly but will in future be available to non-members. It will include some of the material at present appearing in Part I of the *Proceedings*. There will be, in future, only three parts of the *Proceedings* (A, B and C), part 'B" being that covering light current engineering. This will be published in alternate months.

Radio Facility Charts.—Six maps showing the aeronautical radio facilities available in the U.K., and tabulated lists of radio communication stations and navigational services, are given in the latest edition (4th) of "Radio Facility Charts" (C.A.P. 111). It is available from H.M.S.O., price 5s.

F.B.I. Register.—The 1955 edition of the "F.B.I. Register of British Manufacturers," issued by the Federation of British Industries, includes, in addition to the usual buyers' guide and directories of trade names and associations, glossaries in French, German and Spanish. Each glossary gives a translation of all the 5,000 or more names of commodities and services under which the 6,800 member-firms are classified. The register is obtainable from our Publishers, price 2 guineas, post free.

The 80 or more technical papers presented at the tenth **National Electronics Conference** held in Chicago, Ill., from October 4th to 6th will be published in Vol. 10 of the *Proceedings* of the conference which will be available (price $5.00) from the N.E.C. Inc., 84, East Randolph Street, Chicago, Ill., early in 1955.

Many radio and electronic concerns are included in the list of donors to the **Electrical Industries Benevolent Association** given in its 1954 Year Book, which also incorporates the annual report and accounts for 1953. The collections at the Radio Industries Club luncheons in London are given to the E.I.B.A. and last year totalled £487.

An explanation of modern **Costing Techniques** and their application to production engineering is given in "Cost Accounting and the Engineer," by Kenneth B. Mitchell. Published by Iliffe & Sons Ltd., Dorset House, Stamford Street, London, S.E.1, for *Machine Shop Magazine*, the 126-page book costs 10s 6d.

The American **Audio Engineering Society** has elected as its new president Albert A. Pulley, manager (general recording) of the R.C.A. Victor Records Division of the Radio Corporation of America.

BUSINESS NOTES

An industrial television camera has been set up by **Pye, Ltd.**, in the experimental workshop of Smith Meters, Ltd., of Streatham, to improve the liaison between the experimental workshop and the design engineer's office where a receiver has been installed. With this closed-circuit equipment the piece of apparatus or diagram on which a question has arisen is placed before the camera and with the aid of the internal telephone the query is settled without the designer having to leave his office.

Wafer switches in small quantities, made to one's own specification are obtainable from **Specialist Switches.** They are the well-known Type "H," made from parts manufactured by A. B. Metal Products to whom orders for bulk supplies should be sent. Enquiries for Specialist Switches—by post only—should be addressed to 24, Cranbourn Street, London, W.C.2.

Two 650-ton trawlers now being built in a German shipyard for Grimsby fishing companies are to be fitted with **Redifon** marine radio-communication and d.f. equipment.

Twelve tankers now in course of construction for the Shell fleet—five of them of 31,000 tons—are to be fitted with **Marconi** radar equipment.

A mobile radio installation has been supplied by the **General Electric Company** for the transport section at the Coryton, Essex, oil refinery.

The name of Rees Mace Marine, Ltd., the Pye marine radio subsidiary, has been changed to **Pye Marine, Ltd.** Administration, production and sales departments are now at the new factory at Oulton Works, Lowestoft, Suffolk (Tel.: Oulton Broad 425).

The Duke of Edinburgh recently opened Ferranti's new electronics research laboratories at Crewe Toll, Edinburgh. He is seen here being shown an electronically controlled milling machine by D. T. N. "Amplifier" Williamson, who is now senior development engineer in the Industrial Application Laboratory. On the left is the Minister of Supply.

Four Nera projection television receivers (4×3ft) have been installed by the B.B.C. in the television theatre at Shepherds Bush so that studio audiences can see the transmitted picture as well as the stage show. Two of the receivers are suspended from the ceiling, the other two, using a folded optical path, are installed in the circle boxes. The pictures are remotely controlled from a vantage point in the theatre.

We are informed that the **Ampex Corporation,** of California, U.S.A., whose tape duplication system was referred to in our last issue (p. 530), is represented in this country by Rocke International, Ltd., 59, Union Street, London, S.E.1 (Tel.: Hop 4567).

Midland Silicones, Ltd., of 19, Upper Brook Street, London, W.1, are the distributors of the silicone products of Albright and Wilson, Ltd., who have brought into service a new silicone plant at Barry, Glamorgan. One use of silicones in the radio industry is as a coating for resistors to improve their resistance to moisture.

Lasky's Radio have opened new premises at 42, Tottenham Court Road, London, W.1 (Tel.: Langham 1151). Post orders are still dealt with at 370, Harrow Road, London, W.9.

Arrell Electrical Accessories, Ltd., is the new name under which R. Lowther, Ltd., manufacturers of television aerials, of Vincent Works, New Islington, Manchester, 4, will in future operate.

A new servicing depot and research laboratory at Wallisdown, Bournemouth, has been opened by **Good Listening, Ltd.,** who provide a radio and television rental service from their 12 branches.

The Bedford depot of **British Insulated Callender's Cables, Ltd.,** has been closed and a new depot opened at 81, Dumfries Street, Luton, Beds (Tel.: Luton 6866).

Standard Telephones and Cables, Ltd., have moved their Leeds branch office and cable depot (rubber, plastic and textile insulated) to 6-8, York Place, Leeds, 1 (Tel.: Leeds 22900).

EXPORTS

A research centre has been opened by **Export Packing Service, Ltd.,** of Sittingbourne, Kent, to study the packing of equipment for export. Manufacturers of electronic components and equipment are invited to submit prototypes for advice on packing. This new research and development establishment, which covers 16,000 square feet, includes physics and chemical laboratories and a test section with humidity chambers, vibration and "drop" tests and an immersion tank.

Pye, Ltd., of Cambridge, have received a contract from the Thailand police for over £100,000 worth of telecommunications equipment, including a large quantity of new 60-watt h.f. sets.

Components.—Quotations from U.K. manufacturers for the supply of a quantity of fixed and variable capacitors and resistors, and i.f. transformers (455 kc/s) are required by the Director of Industries, Department of Industrial Development, Khairpur Mirs, Khairpur State, West Pakistan. Details of values and quantities are obtainable from the Export Services Branch, B.o.T., Lacon House, Theobalds Road, London, W.C.1 (Ref. ESB/25652/54).

Tape Recorders.—Frank Loasby, of the Raytheon Television and Radio Corporation, 5921, W. Dickens Avenue, Chicago, 39, Illinois, U.S.A., would like to get in touch with United Kingdom manufacturers of tape recorders. The Corporation is contemplating developing several new receivers which will incorporate tape recorders and is, therefore, interested in contacting manufacturers who would be willing to supply the basic tape recording chassis without the loudspeaker and other sound reproducing equipment.

Californian Agency.—The Clyde Allen Company, of 1355, Market Street, San Francisco, California, U.S.A., would like to act as agents for manufacturers of tape and wire recorders, portable gramophones and valves.

LEGAL REPORTING

Use of Tape Recorders in the Courts

By T. D. CONWAY
B.Sc.(Eng.), A.C.G.I., A.M.I.E.E.*

Arrangement of the recording unit and the five microphones in No. 1 Appeals Court.

THE recording of court proceedings is now being seriously considered and, in order to examine some of the problems involved and study the techniques necessary, a prototype equipment has been built and installed in the No. 1 Appeals Court at the Law Courts. This was arranged by the Association of Official Shorthand Writers. In this article we shall discuss the special requirements which had to be met in the design of the equipment, and detail how these facilities were provided for.

Basic Requirements.—In the court where the installation was to be made the whole proceedings are taken down in shorthand, and this, after transcription, is the official record of the court. Tape recording was introduced to provide a simultaneous recording of the shorthand version with a view to determining whether the possibility exists of eventually replacing the shorthand version by a taped one. In practice, the recording equipment had to come under the control of the shorthand writer and be arranged in such a fashion that he had complete charge of it. It further followed that the maximum simplicity of controls must be provided so that the minimum of attention would be required to operate the equipment.

The space available for the recording equipment was not great, but provision had to be made for up to three hours of recording without reel change; additionally, reliability demanded that a minimum of two machines were employed in order to allow for possible breakdowns. The total available floor area was 1ft 6in by 2ft, and the overall equipment height could not exceed that of the writer's desk (2ft 4in) since the keynote of the installation was to be its unobtrusiveness. The accompanying photograph shows the general layout of the court, the judges' microphones being marked Nos. 1, 2 and 3, and those of the counsel 4 and 5: the shorthand writer's position is shown with the recording equipment beside him.

Technical Problems.—The technical problems involved were twofold. First, that of satisfactorily recording the inputs from five different microphones at levels varying from a murmur to loud conversations, and, secondly, recording court proceedings up to three hours continuously without the necessity for changing of tape reels. In normal tape recording continuous monitoring of the recording level is necessary to ensure that the recording stays within the dynamic range of the instrument; thus it must not be so low that it sinks into the noise and hum level, nor so high that it exceeds the maximum allowable distortion on the tape. In this case any form of monitoring was completely out of the question.

For the microphone inputs a special mixer unit was developed having a separate pre-amplifier chain with automatic gain control for each microphone: by the use of a.g.c. the recording level of the tape recorder can be kept within a relatively narrow dynamic range. A two-position sensitivity control was provided on each channel, the low sensitivity being for the judges, who would be close to their microphones, and the high sensitivity for the counsel, who would be from 5-15 feet from the microphones. Details of this mixer unit and a circuit diagram follow in the next section.

For the actual recording it was decided to employ a Grundig TK9 machine since it is compact (15in by 13in by 8½in) and has the facility of recording on both tracks of the tape without reversing the reels: the economics of the situation make half-track recording imperative. This machine operates at 3¾in per second and although there is no doubt that perfectly satisfactory speech recording can be made at 1⅞in per second, it was decided to use a standard machine in the interests of simplicity and economy. The 850-foot tape provides 45 minutes of recording in each track, a total of 1½ hours, and hence two machines provide a virtually continuous three hours

* Grundig (Great Britain) Ltd.

of recording, besides giving provision against breakdown, when one machine may be used alone by changing the tape after 1½ hours.

A master change-over switch from the first recorder to the second was provided, and this changes over the input as well as stopping and starting the respective machines. Owing to the switching complexity involved it was decided to employ a relay operated by a simple toggle switch.

Mixer Unit.—The circuit of one microphone channel of the mixer unit is shown in the figure. The microphones are all of 200 ohms balanced impedance, which has been found to be a good compromise level for the minimum pick-up of hum and signal attenuation on long leads. Each microphone is connected to its own input transformer which feeds into the grid of an EF86. The EF86 has switchable alternative anode loads of 230 kΩ and 30 kΩ, which act as the two-position sensitivity control.

Conventional coupling is made to the grid of the EBF80 *via* the volume control, which in practice has to be varied very little, and it will probably be dispensed with in later designs. The diodes of the EBF80 are fed directly from its anode output into a 10-MΩ load, and the a.g.c. voltage is passed *via* a filter network to the grid of the EF86; a.g.c. delay is provided by a cathode auto bias voltage. The time-constant of the a.g.c. feed is fairly critical in practice, as it must not produce too serious distortion by rapid compression, nor must it be too slow to follow the intensity variations of speech which may be emphasized by the speakers' movements to and fro. It first appeared that it would be advantageous to use the variable-mu characteristic of the EBF80 for a.g.c. purposes, but experiments showed that in this arrangement the ratio of a.g.c. feed of the two valves becomes quite critical and unstable operation may easily result as the setting of the volume control is changed.

Each channel develops approximately 3 volts of r.m.s. signal and since half a volt is adequate for the 500-kΩ input of the TK9, a 1-MΩ isolator was added in series with the output to prevent interaction of the individual a.g.c. circuits.

The general appearance of the mixer unit may be seen in the second photograph, where are shown the five two-position sensitivity switches and their respective volume controls. The master change-over switch for the two recorders, on the top left-hand side of the panel, controls the relay which simultaneously changes over the input from the first recorder to the second, and controls their operation through their respective remote control sockets; indicator lights are provided to show which of the two recorders is in operation.

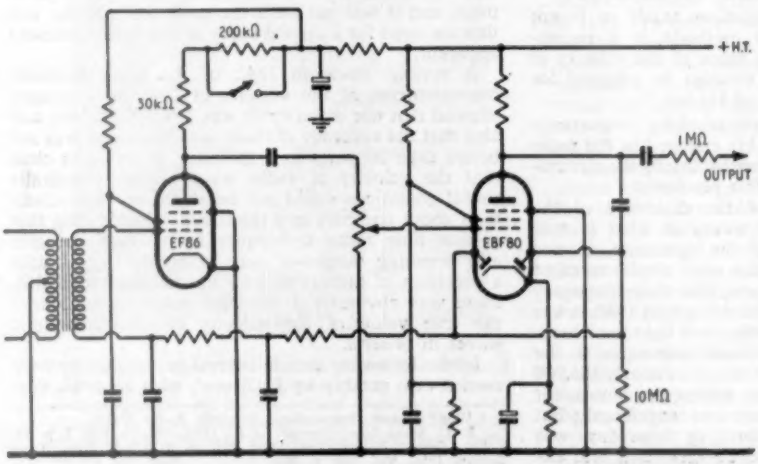
Mounting of recorders and mixer unit.

General Arrangements.—The two tape recorders and the mixer unit were mounted on to a trolley designed to fit into the limited space available. All microphones plug directly into the back of the mixer unit and interconnecting cables are run from the input and remote control sockets of the tape recorders into the mixer unit.

Space limitations made it impossible to locate the power supply for the mixer inside the case, and hence a separate unit was located at the back of the trolley, providing h.t., l.t. and a d.c. supply for the change-over relay: this had the added advantage of eliminating cooling problems in the mixer, which is only ventilated by small bottom and back louvres.

Operation.—To operate the equipment both machines are first loaded with tape. The mixer and the two recorders are then switched on, and their

Circuit of one of the five amplifiers in mixer unit.



respective recording buttons are depressed. The sensitivity switches on the five microphones are next set according to the nearness of the various speakers, and trial speeches are used to set the volume controls of the five channels in accordance with the "magic eye" programme level meters of the TK9s. Overall control of each recorder is provided by the built-in recording level control, and this is set in accordance with the "magic eye" of each machine to limit the distortion on the loudest passages of speech. Owing to the a.g.c., the setting of all channel controls is very uncritical and once settings have been decided upon the equipment may be left untouched. Generally speaking, the output of the mixer unit only varies between very close limits and most adjustments are made on the master recording level controls of the recorders.

To commence recording the track button of the No. 1 machine is depressed, the change-over switch being in the No. 1 position, and continuous recording then ensues for ¾-hour. At the end of this period Track 2 button is depressed to give a further ¾-hour.

Whilst machine No. 1 is in operation the Track 1 button of No. 2 machine is pre-set, so that this machine is ready to start immediately after Track 2 becomes full on the No. 1 machine, by operating the change-over switch. If a particularly long session has to be recorded, a second tape is fitted to the No. 1 machine whilst No. 2 is in operation and the change-over carried out as before.

Finally, it should be noted that both machines are fitted with automatic stop foils at either end of the tape, so that, in the event of tracks or machines not being switched over, the machine in use switches itself off automatically. A third TK9 was provided with the installation so that transcription could commence immediately one tape is full. This machine is provided with stethoscope earphones and a foot-operated remote control having "back-space" facilities.

Conclusion: Other Applications.—The equipment has now been in use for several months and has proved itself extremely simple to operate and reliable in its performance.

Equipment of this kind is capable of wider applications than court recording and is particularly convenient for all forms of conference recording. Since the mixer is designed on a unit channel basis, there is no limit to the number of microphones which can be incorporated. For this application, push-to-speak buttons would be employed to reduce the general background noise normally emphasized by the a.g.c. and signal lamps would be needed on the microphones to indicate that they are live.

Velocity of Radio Waves

An Internationally Agreed Value

By R. L. SMITH-ROSE* C.B.E. D.Sc., M.I.E.E.

AT the 11th General Assembly of the International Scientific Radio Union (U.R.S.I.) held at the Hague in August-September, 1954, the following resolution, first formulated two years earlier, was confirmed:—

> "As a result of investigations made in recent years by several different methods, it is recommended that the following value of the velocity of electromagnetic waves in vacuum be adopted for all scientific work: 299,792 ± 2 km/sec."

As this is a matter of far-reaching importance to many scientists and engineers engaged in the radio field, it will be interesting to review briefly the circumstances which have led to this resolution.

From the earliest days of the discovery of the existence of electromagnetic waves in what is now known as the radio part of the spectrum, it was appreciated that their properties were similar to those of light waves, except, of course, that their frequency or wavelength was different. Prior to about 1940, it was also usually assumed that the velocity of light, and therefore of radio waves, was approximately equal to the nice round number of 3×10^5 km/sec (or nearly 186,000 miles per second). This was extremely convenient for the conversion of frequency into wavelength; but what was not always appreciated in those days was that, whereas frequency could be measured and expressed to a precision of better than one part in ten million, the wavelength derived by the above arithmetical process had nothing like this accuracy. This fact was not of much consequence for many applications, and it was not until the early years of the war that the need for a careful study of this matter became apparent.

A review[1] made in 1942, of the latest available measurements of the velocity of light in a vacuum showed that the mean value was 299,775 km/sec, and also that the accuracy of these measurements was not better than 50 parts in a million. It was also clear that the velocity of radio waves under practically useful conditions could not be stated more precisely than about one part in a thousand. Considering that at that time radar techniques for navigational aids and bombing purposes were being developed with a precision of indication very much better than this, there was obviously a need for more research into the true value of the velocity of electromagnetic waves in general.

In the following decade several investigations were carried out, notably by L. Essen[2], who, in 1947, des-

* Vice-President International Scientific Radio Union.

[1] R. L. Smith-Rose: *Journal I.E.E.*, 1943, Vol. 90, Part I, p. 31.

[2] L. Essen: *Nature*, 1947, Vol. 159, p. 611, and *Proc. Royal Society*, 1950, Vol. 204, p. 260.

cribed a method of deriving the value of the velocity of radio waves from the resonant frequencies of a cylindrical cavity. Using the resources of the National Physical Laboratory for the measurement of the dimensions of the cavity in the Metrology Division and the frequency in the Electricity Division, he obtained a value about 17 km/sec greater than the hitherto generally accepted value for the velocity of light referred to above. This result was soon confirmed by other workers. Concurrently, the apparent discrepancy between the values applicable to the velocity of light and of radio waves was later resolved by E. Bergstrand[3] in Sweden, who applied modern techniques to the classical methods of measuring the velocity of light.

At the General Assembly of U.R.S.I. held in Sydney in August, 1952, a paper by L. Essen contained the following summary of the latest results obtained for the measured velocity of electromagnetic waves in a vacuum:

Date	Author	Method	Result—km/sec
1950	Essen	Cavity Resonator	299,792.5±1
1950	Bergstrand	Optical	793.1±0.25
1950	Bol	Cavity Resonator	789.3±0.4
1951	Aslakson	Radar	794.2±1.4
1952	Froome	Interferometer	792.6±0.7

The arithmetic mean of these results gives the value 299,792 km/sec with a probable error of ±2 km/sec. Further measurements by other investigators have since confirmed this value, which is thus recommended for adoption in accordance with the resolution quoted at the beginning of this article. When applied to practical radio conditions, this velocity will usually be modified by the dielectric constant of the atmosphere or by the conductivity of the earth's surface, depending upon the actual frequency and mode of transmission used. Recent research, which is still in progress, has provided a knowledge of the appropriate corrections to be applied for various typical conditions.

[3] E. Bergstrand: *Nature*, 1950, Vol. 165, p. 405.

The illustration shows the helical aerials and their reflectors used for a multi-channel telephone system for a summer camp in a somewhat isolated part of Yugoslavia. It was obtained by A. O. Milne, president of the R.S.G.B., while attending the Congress of the Yugoslav Amateur Radio Society this year.

Television Safety Precautions

By E. G. GOODHEW* M.I.E.E.

THERE are, of course, possible hazards—such as electric shock and fire—involved in the use of a television receiver, as with any high-voltage equipment. There is, however, the additional danger of physical injury due to the implosion of the c.r. tube and the remote possibility of X-radiation. In this country the drafting of safety precautions for television receivers is the concern of one of the British Standards' Committees (TLE 2/2) which is drafting the ninth, and, it is hoped, the final revision of B.S.415.

On the international level such matters are the concern of a sub-committee of the International Electrotechnical Commission (I.E.C.) which, in September, held its jubilee congress in Philadelphia. The main item on the agenda of this committee (telecommunications safety, 12-2) was the consideration of a draft of "safety requirements for electric mains-operated television receivers."

During the post-war years, the meetings of this I.E.C. Committee have been held in Europe, and as a result, the recent meeting was the first at which the U.S.A. had been adequately represented. The United States delegation included engineers from the Underwriters' Laboratories Inc., whose approval must be obtained for domestic and other equipment offered for sale in the U.S.A. They have therefore tested for safety many more television receivers than any other laboratory, and their experience was invaluable to the Committee.

The television safety precautions considered at the Philadelphia meeting will be a supplement to I.E.C. publication 65, "Safety Requirements for Electric Mains-Operated Radio Receiving Apparatus," issued in 1952. In this document a safe condition is specified for the receiver in its normal operating condition and under abnormal conditions when short-circuits are applied to certain spacings which are smaller than those considered sufficient to ensure safety in themselves. This principle is also followed in the revision of B.S.415.

The new problems not already contained in publication 65 are those relating to the higher voltages involved. Acceptable spacings for voltages up to 4,500 have been determined experimentally, but above this value the shape of electrodes and conductors has an increasing effect, and while the present method of specifying breakdown voltages is deemed to be satisfactory, it is to be expected that further experience will indicate more satisfactory methods.

Even when the mains supply has been disconnected, removal of the back-plate may involve a hazard due to the charge on the capacitor of the high-voltage source. It had been intended to specify

* Philips Mitcham Works, Ltd. [The author was a member of the British delegation to the I.E.C. Congress, Philadelphia.]

a limit for the charge, but experiments being conducted in the U.S.A. tend to show that the hazard is more accurately specified by the energy than the charge. Until more is known, the I.E.C. has adopted a method of limiting the capacitance, used successfully by the Underwriters' Laboratory for some time. This specifies that the capacitance shall not exceed 3,000$\mu\mu$F and that the sum of the total capacitance in $\mu\mu$F plus 300 times the voltage in kV shall not exceed 7,500.

Metal cabinets are appearing on the American market particularly for use in hotels. The majority of receivers in the U.S.A. are transformer fed, and therefore no particular hazard is involved when the cabinet is connected to the negative of the high-voltage supply. Receivers having a series heater chain and the chassis connected to one pole of the mains, must have the cabinet insulated from the chassis by a material appropriate to the voltage of the mains supply. Should the insulation break down, one pole of the mains supply would be connected to the cabinet.

Circuits have been designed to overcome this difficulty. They will be studied in the light of the prevailing conditions in Europe (e.g., higher mains voltages).

With minor changes, the requirements regarding fire hazard specified in publication 65 were considered satisfactory.

Experience has shown that the probability of a cathode-ray tube imploding is not very high. Nevertheless it is necessary to be certain that the enclosure, and in particular the protective screen, are strong enough to ensure safety should a tube implode. Attempts in the United Kingdom to find a satisfactory impact test have not been entirely successful, and it is therefore necessary to cause a tube to implode in order to test its enclosure. Of the various methods which have been used, that of driving a steel pin into the tube seemed to be the easiest to carry out, and as the Underwriters' Laboratory had already carried out about 1,000 tests, the standards which they have adopted were accepted by the Committee. Through a hole drilled in the cabinet housing the tube, a steel pin 1in in diameter is driven into the tube at a point on the rim of the face by a weight, which varies according to the diameter of the tube, falling from a height of five feet.

At the voltages in use on direct-viewing cathode-ray tubes, X-radiation is a hazard which need give no concern. Even using projection-type tubes operating at 25kV, it is very difficult to measure any X-radiation outside the optical system assembly. The limit of 0.6 micro rontgens/second accepted by the International Electrotechnical Commission agrees with that included in the draft of B.S.415 and is one-third of the value given by the International Commission for Radiological Protection as a safe dose for eight hours' continuous exposure.

EUROPEAN BROADCASTING

Technical Work of the E.B.U.

THE General Assembly of the European Broadcasting Union and the statutory autumn meeting of its Administrative Council, which are held in a different country each year, were this year held in London. The opportunity was taken also to hold meetings of the Legal, Technical and Programme Committees. At the meeting of the Technical Committee, at which E. L. E. Pawley (B.B.C.) was chairman, there were representatives from 18 member-countries, 3 extra-European associate-member countries, the C.C.I.R. and the I.F.R.B.*

The technical work undertaken by the E.B.U. falls roughly into two categories—(i) routine and special studies undertaken by the Technical Centre in Belgium and (ii) studies delegated by the Technical Committee to individual Working Parties of experts, specially nominated for that purpose.

At the London meeting, the Technical Committee first of all worked out a plan extending over the next five years for completing and improving the technical equipment of the Union's receiving and measuring station at Jurbise-Masnuy, Belgium, which was officially opened in July, 1953. Routine operations are to continue on approximately the same lines as hitherto, except that more attention is to be given to observations in the v.h.f. bands. After studying the present situation on long and medium waves, the committee recommended the use of Band II by its members for local and regional transmissions.

The reports of the Working Parties presented at the meeting covered:—A long-term study of indirect-ray propagation on medium waves that should prove of great value when these bands are reallocated; unattended sound and vision transmitting stations; magnetic recording, including the standardization of sound-recording in television and the recording of television picture signals; v.h.f. and u.h.f. sound and television broadcasting (incidentally, the programme of propagation experiments in Band IV has been deferred until more members have the necessary equipment); and the transmission of television over long circuits including the exchanges of television programmes in Europe.

It was decided to reconstitute the ad-hoc Committee which has been co-ordinating the recent European television exchanges as a Working Party, with M. J. L. Pulling (B.B.C.) as chairman, and to include representatives of the television services of Luxembourg and Sweden. The terms of reference of the new Working Party are the planning, direction and technical supervision of international television relays.

The Technical Centre was instructed to issue as soon as possible a draft Code of Practice relating to international television relays. The question of the provision of a permanent international television co-ordination centre to replace the temporary arrangement at Lille was discussed at length. It was decided that, in the present state of development, it was too early to say whether such a centre would always be necessary, but that the E.B.U. should accept responsibility for the co-ordination.

* International Radio Consultative Committee and International Frequency Registration Board permanent organs of the International Telecommunication Union.

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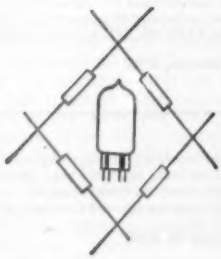
- **the first electro-static tube.**



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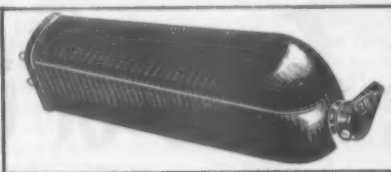
HGP 37-1 Collaro		A Hi-g pick-up head incorporating the HGP 37-1 turnover cartridge with cantilever sapphire styli. Designed for both standard and microgroove records. Will fit Collaro units RC 532; AC 534; AC3/534; 3RC 532 and the Studio pick-up. Available in cream or walnut. *Ask for Data Sheet No. 4800.*
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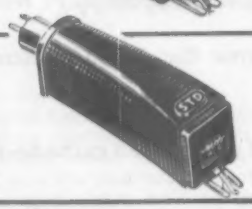
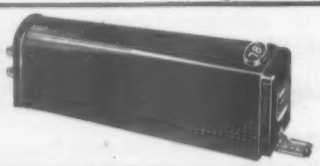
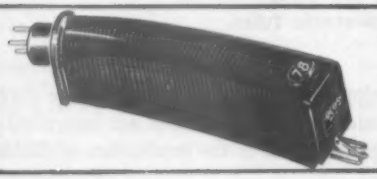
HGP 39-1		Hi-g pick-up heads incorporating cantilever sapphire styli. Separate heads for standard and microgroove records. Will fit the Acos GP 20 pick-up arm and the Garrard C type adaptor. Used on the following Garrard units: RC 72A; RC 75A; RC 80; and the model M unit. Can be used on any units which at present use the GP 19 heads. *Ask for Data Sheet No. 4400.*
HGP 35-1		Separate plug-in type Hi-g heads for standard and microgroove records; fitted with cantilever sapphire styli. The crystal unit is identical to that of the HGP 39-1 above. Can be used on Garrard units RC 75M; RC 80M; RC 90; RC 111; and the TA player. *Ask for Data Sheet No. 4000.*
HGP 41-1		Separate Hi-g plug-in type heads for standard and microgroove records incorporating the crystal unit as used in the HGP 39 pick-up head. Will fit Collaro units RC 532; AC 534; AC3/534; 3RC 532. Available in cream or walnut. *Ask for Data Sheet No. 4500.*
HGP 45		Separate Hi-g pick-up heads for either standard or microgroove records. The crystal unit is identical to that used in the HGP 39-1 head. Will fit Garrard units RC 80; RC 72A; RC 75A; and the Model M player. Can be used on any unit which at present uses the Garrard C adaptor with GP 19 heads. *Ask for Data Sheet No. 4600.*

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LETTERS TO THE EDITOR

The Editor does not necessarily endorse the opinions expressed by his correspondents

Quality on V.H.F.

MAY I comment very briefly on the editorial about v.h.f. in your November issue. I said in my talk to the Radio Industries Club that the new v.h.f. stations would give improved quality because of reduced background noise, but I also said that the B.B.C. did not intend to transmit an audio-band up to 15 kc/s because the frequency characteristics of the Post Office music circuits would not permit it.

But, of course, I agree with you, and I hope this was clear from what I said, that the absence of background noise will bring out the difference in quality of reproduction between v.h.f. and what is possible at the present time on medium waves. The serious irritation of "monkey chatter," which is heard if the frequency characteristics of a medium-wave receiver goes much above 5 kc/s, will be overcome, and the new service will permit a substantial improvement in receiver performance which will we hope be very welcome to the vast majority of listeners and certainly to the B.B.C.

Director of Technical Service, B.B.C. H. BISHOP
London, W.1.

Output Stage Performance

MR. WOODVILLE is correct in his statement that "ultra-linear" operation can produce considerably less distortion than either tetrode or triode operation.

I drew attention to the advantages of this circuit as long ago as 1943. Since then, however, the principle has had to travel across the Atlantic and back again before becoming generally popular with designers. During this process it has been incorporated in many amplifier designs with both good and bad results. Much depends on how the principle is applied; there are several alternatives.

For example, having a percentage of the output winding common to screen and anode, part or all that percentage can be placed in the cathode circuit (*Wireless World*, September, 1950). This gives greater freedom to the designer in integrating the output stage with the requirements of the amplifier design as a whole.

The Acoustical Manufacturing Co. P. J. WALKER
Huntingdon.

GRAHAM WOODVILLE, in your November issue (p. 555), makes out a convincing case for the adoption of distributed-load tetrodes in the circuit under discussion, but a few comments may not be out of place.

Would it not be more reasonable to assume a maximum output of six watts per pair for the N709 when triode-connected, if the sharp increase in the curve at this point can be taken to indicate the onset of grid current? The distortion is then 1 per cent. Mr. Woodville's figures show 100 per cent increase in distortion for an increase of only 0.5 watt. The more gradual rise in the curve for the distributed-load condition is a characteristic of the circuit, and I think it is possible that grid current does not start until the maximum output of 14 watts is reached, with a distortion figure of 1.5 per cent. The advantage of the circuit would then appear to be chiefly in increased power efficiency. This criticism is, perhaps, unfair, and is invalid if Mr. Woodville's curves apply strictly to the Class A condition.

The application of negative feedback produces a different state of affairs, and a direct comparison is available in the published distortion-percentage/wattage output curves of such amplifiers as the Williamson and the Acoustical Quad II, the latter amplifier, of course, having the load distributed between anodes and cathodes.

The subject is discussed at some length in the article "Amplifiers and Superlatives," by D. T. N. Williamson and P. J. Walker (*Wireless World*, Sept., 1952). The figures given in that article, of relative distortion just below onset of grid current, are 1.0 and 1.5 for triode-connected tetrodes and tetrodes with load distributed between anode and screen, respectively, which would appear to bear out my observations on the N709 case.

The term "ultra-linear," which is meaningless, can have no justification, and should be abandoned on this side of the Atlantic, unless "Free Grid" can think of a use for it.

Birmingham. NORMAN F. BUTLER

"*Inexpensive 10-watt Amplifier*"

I THINK E. F. Good is raising a mare's nest in his letter in your October issue. Whilst the form of coupling shown in the Mullard circuit does not go down to d.c., it is fairly satisfactory for 10 c/s or so, which is quite a good limit for an inexpensive amplifier.

Mr. Good's point concerning the tertiary winding calls for some comment. In point of fact I was quoted six guineas for a Baxandall transformer, which is about the price of the classical Williamson output transformer. Hence there seems no saving in money by using the tertiary winding. I would not be dogmatic about it, but I think the high price may be due to patent royalties accruing to the holder of the patent cited in Baxandall's references.

The other aspect in Mr. Good's letter is valid: viz., instability with capacity loads. I knew one Williamson enthusiast build a Baxandall amplifier because a cross-over network made his Williamson unstable.

London, N.W.11. F. B. WHITE

A.C./D.C. Dangers

"DIALLIST" (November issue, p. 579), would have us believe that a chassis of the a.c./d.c. type cannot be of any danger when operating on d.c. mains. Nothing could be further from the truth and I sincerely hope none of your readers discover this the unpleasant way.

Your contributor must surely be aware that most public d.c. supplies are distributed by the three-wire system; consisting of an "inner" (neutral) at earth potential and two "outers" (lives) at potentials equal to normal mains voltage, above and *below* earth respectively. The voltage across the two "outers" is twice the normal domestic supply. The service to domestic premises consists of connections to the "inner" and *one* of the outers." The point is, of course, that it is a fifty-fifty chance that any particular house is using the "negative" outer. When this is the case the positive side of all wiring therein will be virtually at earth potential and the negative side at mains voltage *below* earth and accordingly alive. Under these conditions, in order to operate at all, an a.c./d.c. type sound or television set *must* have its chassis connected to this *live* side of the mains and all the usual hazards will be present.

Like "Diallist," I do not like the growth of the a.c./d.c. technique in the receivers of to-day. I do not, however, think the solution lies in making the dealer responsible for the correct fitting of a 3-pin plug; for the simple reason there would be no guarantee, that immediately the dealer left his customer's house, the plug would not get changed, the flex extended, or some other modification carried out to meet the exigencies of the household concerned. In any case, the conditions regarding d.c. mains, discussed above, might exist and he would, in fact, be faced with an impossible task because the set just could not work at all when connected the safe ("correct") way.

Most manufacturers ensure that a.c./d.c. sets bearing their name are adequately insulated and users need have no fear of danger, provided the back of the set and/or

control knobs, etc., are not removed without first completely disconnecting from the mains. My own personal view is that *all* mains radio and TV receivers of the domestic type should be fitted with small "gate-switches," similar to those usually found on commercial and service transmitters (also on burglar alarms). This would ensure that the back of the set be firmly and properly affixed when in use. Also, any screws, control spindles, etc., projecting from the cabinet should be completely insulated from the main chassis.

It is true almost all set makers see that chassis bolts are suitably covered and control-knob grub screws recessed and wax covered when a set leaves the works. But how many dealers see that the same state of affairs exists after a set has been serviced? Very few.

King's Lynn, Norfolk. A. B. GRIEF.

Band III Television Interference

WHILST appreciating that F. R. W. Strafford's article in your October issue is of a tentative nature, I feel he has painted too gloomy a picture of the problems of suppression at Band III frequencies so far as domestic appliances and other small commutator motors are concerned. This is to be regretted at this stage as it may cause unnecessary discouragement to the large number of manufacturers, dealers and members of the general public who are now fitting Band I suppressors to appliances, and they may be tempted to discontinue the good work until Band III problems are resolved.

The dominant note of the article is set by the photograph of electric shaver interference on Band III. Now unless the test was made with true transmission on Band III frequency and reception on a *Band III aerial system* (and the text does not imply this), it can be most misleading. Band III aerial systems are highly directional and interference from sources other than those situated on the line from receiver to transmitter will have less effect at the receiver than in corresponding circumstances on Band I. It seems, therefore, that higher interference noise levels may be tolerable on Band III than on Band I. Incidentally the electric shaver is not typical of small motors generally. It does not figure in the 1953 list of most frequent causes of TV interference compiled by the Post Office, and is not likely to be frequently in use during peak viewing hours. Furthermore, most shavers are of the impulse motor type in which the interference derives from the pulse waveform in the contact circuit of the order of 2 kV peak having a frequency spectrum quite different from that of a normal commutator motor.

Mr. Strafford has described how self-resonant inductors fitted in the mains lead to an appliance are ineffective at Band III frequencies. This is, of course, to be expected since suppressors so used are not working to their maximum efficiency, even on Band I. Such limited measurements as we have made to date show that Band I suppressors efficiently fitted *within* the appliance give in many cases a good measure of suppression at Band III frequencies and are expected to prove adequate at these frequencies when other factors appertaining to Band III (e.g., aerial characteristics) are taken into account. Since many motor manufacturers are already fitting such suppression within the motor the outlook on Band III is reasonably encouraging. For special cases not responding to Band I techniques and available components, development work now in hand will, I believe, provide the answer.

Dubilier Condenser Company. R. DAVIDSON.
London, W.3.

Tape Machines

COULD not some enterprising manufacturer of tape recorders let us have a twin-track machine which automatically reversed itself at the end of each track, preferably taking spools up to 1,000 metres? As so very much has been done to give the disc user long duration surely a much simpler device would prolong the unattended playing time of tapes, and without any sacrifice of quality.

Even with the much improved Continental spools, loading and threading takes time. Again we must hand it to the Continentals for at least making the tape switch off the motor, although a little more thought in locating the metal foils might have left the tape still threaded after fast spooling, instead of over-shooting as at present.

Another bee in my bonnet is against the current craze for more than one tape speed from a single instrument. This increases costs more than would either of the suggestions made in my opening sentence, besides tending to jeopardize performance and reliability, to say nothing of the intricacies imposed on design by the ganged and interlocked switching of at least four different equalizer circuits. The net result of all these complications is simply a compromise between quality and duration.

Since permanent recordings can be made more cheaply on l.p. lacquer discs than on tape (given access to a disc recorder) the overall cost becomes virtually independent of the speed of the tape medium, which is erasable and can be regarded as part of the capital equipment.

Surely what is now wanted is a high-quality twin track recorder of fixed speed (say 7½in/sec) but capable of taking standard 11½-in spools. Although the lid may not be closed whilst playing it should at least be possible to close it afterwards without having to wind off the tape and remove the spools—even the present professional equipment does not always provide for this.

It is admitted that a delay of about 2 seconds would be needed every 90 minutes when reversing the tape, but this would present little difficulty to competent designers and still less to the user whose only alternative is a delay of eight seconds after every single side. Moreover, the best that can now be achieved in really long disc programmes is the indefinite repeat of the last side only, whereas a self-reversing tape machine would repeat the entire programme *ad lib*.

The prime factors of the tape medium would seem to be erasability and unlimited continuity, yet far from increasing spool diameters and tape speeds the manufacturers are in many cases reducing them as if portability were the prime consideration. I am surprised that the other (and comparatively inexpensive) desiderata have not been embodied in at least some current designs, and can only express my willingness to be customer number one when they are.

Grimsby, Lincs. HARRY CRAMPIN.

Dry Battery Life

"DIALLIST" is incorrect in implying (your November issue) that *all* mains/battery broadcast receivers are fitted with combined h.t.-l.t. batteries. The "Ultra Twin," uses separate batteries and has done so for some years.

Ultra Electric, Ltd. C. A. QUARRINGTON.
London, W.3.

Очен Жаш

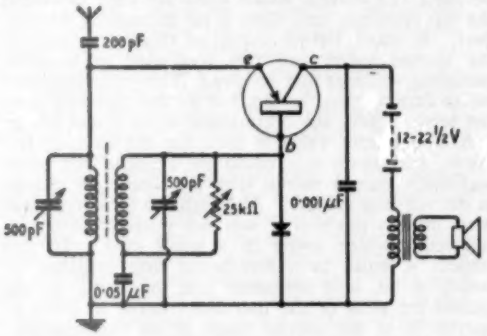
I AM in complete agreement with Dr. Hague on the question of standardizing wherever possible: I am flattered by his great interest. But we are not all librarians and linguists, and we must not alarm the more timid readers. The spellings Tchebysheff and Chebyshev are both used in the literature: there are, I think, one or two more. I have used the spelling which is used by Guillemin, van der Pol and Darlington, because I think the reader is likely to turn to these writers before he turns to Green, or hunts through *Science Abstracts*. (And *Science Abstracts* does not correct the spelling of authors who write Tchebycheff). I remember that the B.B.C. attempted to make us spell Tchaikovsky as Chaikovski, but gave up

in despair. For the advanced work, the convenience of Green's A, B(utterworth) and C(hebyshev) responses are great, though, as Dr. Hague's last paragraph points out, irrelevant. For us, though, Tony Weller had the answer: "Spell it with a Wee, me lord, spell it with a Wee."

THOMAS RODDAM.

Transistor Circuit

AS junction transistors of various types are now generally available, many of your readers will no doubt be trying them in receiver circuits, still an open field of modest experiment for those who have the patience and means to indulge their curiosity. The price of a good transistor is not yet as convenient as its insignificant size; a super-heterodyne circuit will be beyond most of us; but a great diversity of circuits can be tried with a single transistor and germanium diode in different combinations. The circuit herewith, on a fair outside aerial, gives good loudspeaker performance at all times for our local stations (West and Welsh Regionals) and brings in Third Programme and Continentals in adequate volume after dark.



It is highly selective, especially if the transistor can be brought into oscillation, which is not the case with all types or with all samples of the same designation. The one used here is a Standard Telephones & Cables LS/828, which gives 2-3 mA with 12-22½ volts on a local signal, cut off to 100 μA on no signal—a convenient feature for standby or relay operation as the miniature hearing-aid battery will survive being left on for long waiting periods. We have not tested an LS/828 to destruction but the collector-emitter voltage can be as high as 24 V and, in that condition, with a 45-V battery, over 100 mW can be developed in the output transformer. The coils used are basket-wound on a miniature former with adjustable ferrite core.

Those interested in transistor circuitry in general will note that the signal drive is on the emitter and the rectified signal is derived from the coil in the base. The 25-K variable resistance is used as a volume control to limit oscillation.

A note of warning. A good transistor will oscillate vigorously on the medium waveband and can cause widespread interference. In the words of P. P. Eckersley, Please don't do it!

W. GREY WALTER.
KARL WALTER.

Bristol, 9.

"*Neon Timers*"

THE letter from J. R. Barnard in the November issue of *Wireless World* describes a simplified version of one of the timers in my article in the October number and this illustrates a principle of design. Almost any piece of semi-automatic equipment can be simplified behind the panel provided that extra manual controls are added to the front. In the case of the simplified timer, there is an additional operation; it has to be reset manually. In the original, relay "B" is, in effect, an automatic reset. This is a small point, but in practice it will be found that the elimination of this added manual operation is well worth while.

Actually, the simplified circuit is ideally suited for another purpose in the dark-room, namely, the timing of the exposure of a contact printer. Switch S2 would then become a change-over micro-switch actuated by the closing of the pad which presses the printing paper to the negative. This would switch on the lamp and the pad would be kept closed until it was seen through the small observation port that the timer had switched it off. Releasing the pad would then reset the timer. In this case the values of R1, C1 would have to be modified as the exposure range would be from about one-tenth of a second to five seconds.

For reasonably accurate timing from one exposure to another a voltage regulator tube must be considered necessary and this becomes increasingly important should the timer be moved to a district having a different value of mains voltage and also if it is to be used in an area where there is the possibility of considerable mains variations.

One point relating to both timers which was not mentioned in the original article is that they are suitable for both a.c. and d.c. operation.

Totland, I.o.W. B. T. GILLING.

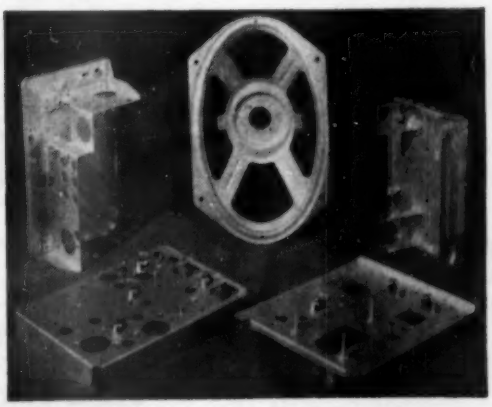
TIN-ZINC PLATING

IN the course of a year a large quantity of steel parts are used in the radio industry, and, while several different protective finishes are in current use, none appears to be entirely satisfactory.

A new process, demonstrated recently by the Tin Research Institute, employs a tin-zinc alloy and it is said to possess all the intrinsic advantages of these two metals but has none of their disadvantages. Zinc is a good rust preventer, but notoriously difficult to solder and prone to corrode, so a thick coating is generally required; tin is good in most respects and takes solder well but is costly. The new coating solders very easily.

It is not restricted to use on ferrous metals, although this is probably its most profitable field, and it has been applied advantageously to brass and other high-copper-content alloys. It cannot, however, be deposited direct on aluminium or, curiously enough, on zinc-based alloys. Its silver-like appearance is extremely pleasing and it will take a polish if required.

Full technical details of the process, together with advice on installation and operation of plant, are obtainable from the Tin Research Institute, Fraser Road, Greenford, Middlesex.



Examples of steel parts with the new tin-zinc finish

Extended-Range

By L. F. SINFIELD

THE usual coverage of 20-20,000 c/s for an audio oscillator is now regarded as sufficient for the exhaustive testing of high-fidelity amplifiers and for general experimental purposes. Also with the increasing use of magnetic recording it is desirable that the range should be sufficiently high to cover the bias and erase frequencies in general use for checking bias filters, etc. The low-frequency end can also be usefully extended, for the purpose of testing industrial electronic equipment. If possible the unit should be small and easily portable.

The optimum coverage of the instrument to be described was set at 6-70,000 c/s, as this would adequately fulfil the above requirements.

The obvious choice was for an oscillator of the Wien bridge type, using a relatively low impedance bridge network. The variable capacitance method would give precise setting accuracy, but against this it is prone to hum pick-up, and at low frequencies the resistors for the required time constant would become far too high. Also the necessary four-gang condenser is too large for compact construction. Ganged potentiometers were therefore used, with fixed capacitors for range switching. At the high frequencies, in order to obtain accurate calibration, it is necessary to have the capacity large enough to swamp any strays so that on the highest range the range condensers are 0.001μF with the lower ranges covered by 0.01, 0.1, and 1.0μF. This gives a required value for the ganged variable resistances of 25 kΩ (with a fixed series limit resistor of 2.2 kΩ) which is a very convenient value in that it enables a preferred value to be used and also makes it possible to obtain smaller sizes of this value in semi-log form. Thus it is possible to build a cheaper, smaller unit; but of slightly less setting accuracy than one using the larger component sizes.

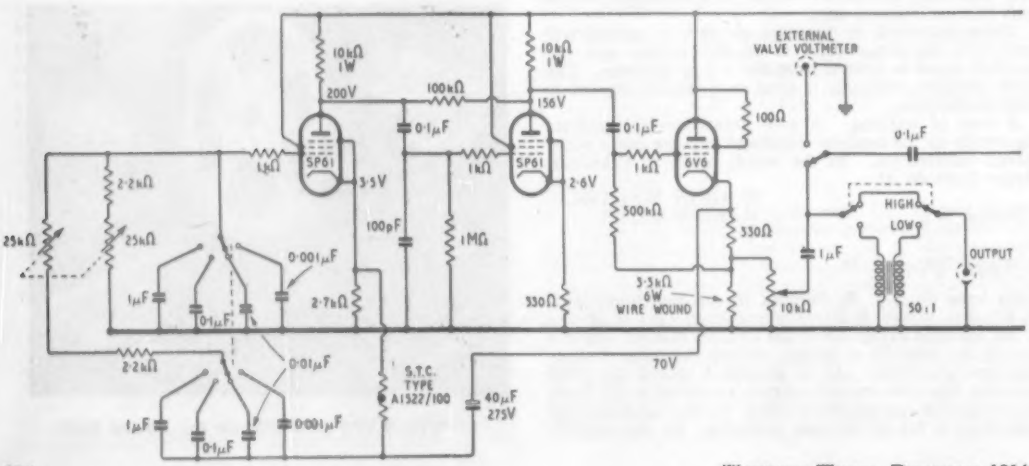
The use of a low-impedance network means that in this case the overall impedance of the network, at the lowest setting is only around 3,000 ohms. To ensure that the amplifier gain remains constant over the frequency range it is necessary that the output impedance of the amplifier be made very small, so that the varying shunt effect of the network on the output load is reduced. This is achieved by inserting a cathode follower. The almost constant gain over the entire range means also that only a small degree of control is necessary to maintain constant amplitude and good waveform, so that the inclusion of the thermistor makes the unit extremely good on these points.

The amplifier itself is quite simple and although SP61s were used there is no reason why other high-slope pentodes such as EF50s or EF91s should not be used. Low-value anode loads are used to extend the top response, and there is no decoupling whatsoever. A small 100-pF capacitor shunts the grid of the second valve, and this was used to suppress parasitics which at first occurred. This only happened on an experimental set-up, but as the capacitor does not seem to have any detrimental effect it was left in.

A 6V6 output valve is used for the cathode follower, and again this could be changed for other high-slope output valves, with any necessary change in the self-bias resistor. Although the SP61 type was tried in this position it was not possible to obtain sufficient voltage swing in a small load. In this respect it must be remembered that initially, on switching on, it is necessary that the swing should exceed the peak of the thermistor curve in order to operate it at the correct point of its characteristic. Unless the thermistor is taken past this peak it will not assume a negative coefficient.

Alternative Outputs

As the unit was intended for feeding into comparatively high impedances the output is simply taken from a potential divider across the cathode load with a step-down transformer for matching into inputs



L.F. Sine Wave Oscillator

A Compact Source for Audio, Sub- and Super-Sonic Testing

such as those intended for moving coil or ribbon microphones. This arrangement is satisfactory for general use, but if required for working into loads which would appreciably shunt the output, and so upset the oscillator, it would be better either to take the output via an attenuator and sacrifice output level for isolation, or to feed the output via a further cathode follower. The reason for using a potentiometer shunted by a resistor is simply that it allows a standard potentiometer value, and also the resistor carries most of the current.

With several miniature Mumetal microphone transformers that were tried as output transformer a lowest frequency of between 15 and 40 c/s was obtained (depending on the particular primary inductance) before the waveform distortion became noticeable. The high frequencies were maintained up to maximum frequency as the low source impedance heavily damps the transformer.

To extend the low-frequency limit at low impedance it would be necessary to use a transformer of larger dimensions with the required high primary inductance, or an alternative more complex output coupling arrangement. It is doubtful, however, if the input transformers into which the unit would feed under these conditions would have such an extended low-frequency response, so that a miniature type was fitted with a 20-c/s lower limit and it was considered that this would be satisfactory for general use. If then the extended low response was required at any time it is always possible to feed out at high impedance and match with an external transformer of better quality.

The feedback capacitor must obviously be of high value to feed back into such a low impedance bridge so that an electrolytic type is used. This is a high-voltage type, *not* bias type, so that leakage current is negligible, as any leakage would upset the correct working of the thermistor. The d.c. voltage at the 6V6 cathode is considerably higher than that of the input valve, so that the condenser is always correctly polarized. In practice the component chosen was a 16-24 μF, 275-V d.c. working, with both sections in parallel. The container must, of course, be isolated from chassis.

A valve voltmeter is incorporated to monitor the output level and is switched so that it can also measure external signals in the same range. This consisted of a small ex-Government meter scaled 0-20 V with a full-scale deflection of slightly less than 2 mA. It is not recommended that this current be exceeded as the current pulses of the valve at low frequencies, below about 12 c/s, cause motor-boating via the h.t. line if greatly exceeded. This f.s.d. current is about the maximum possible and it is advisable to use a more sensitive meter. There are ex-Government meters of 0-15 V scale 0-500 μA which would be ideal. The cathode resistor controls calibration and so would have to be changed to suit other meters. Also the bleeder chain to h.t. would have to be increased proportionately to obtain the correct zero setting of the meter. The anode of the voltmeter valve is returned to the reservoir to obtain better isolation from the oscillator h.t. supply as smoothing is relatively unimportant at this stage. Separate decoupling could be provided, but it introduces extra components.

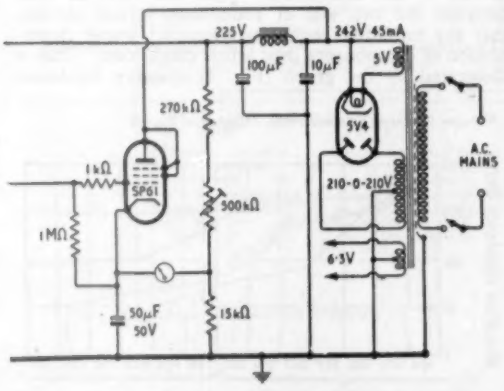


Fig. 1. Circuit diagram with values for an overall range of 6 c/s to 70 kc/s. The two-gang resistors recommended are Reliance TW or PIW, semi-log wirewound.

Extra H.T. Smoothing

Power supply is quite conventional except that the h.t. smoothing is rather large in order to cope with the by-pass of the very low frequencies. However, although the condenser is a 10+100-μF this is quite standard and is both small and cheap. The mains transformer was of 210-0-210 V but any type with an output of between 200-0-200 and 250-0-250 would be suitable.

The whole unit is housed in a cabinet 13in × 6in × 6in, but this is by no means cramped and it would be possible to reduce the size considerably, if desired.

A maximum output of 15 V, r.m.s. is obtained and both the amplitude variation and the harmonic distortion remain negligible over the whole of the frequency range.

To calibrate, selected 1%, 0.01-μF condensers are fitted in the appropriate position and the 600-7000 c/s range marked on the scale, but actually calibrated 6-70 c/s (1/100 of the actual frequency). This is because 1%, 0.01-μF condensers are relatively easy to obtain and the range 600-7000 c/s probably the easiest to calibrate. By actually marking the scale 6-70 c/s it enables the range control to be calibrated as ×1, ×10, ×100, and ×1000. The two lower ranges and the high range are then matched by selecting condensers of slightly low capacity and padding with small parallel condensers to make the scale accurate on each range; only one check point is needed on each range.

PAN-CLIMATIC TESTING

Reassessment of Requirements for Service Equipment

By G. W. A. DUMMER,* M.B.E., M.I.E.E. S. C. SCHULER,* Assoc.I.E.E., and J. E. GREEN*

EVEN in the short period since World War II, conditions under which Service airborne electronic equipment is operated have changed considerably. The increased speeds of modern aircraft have resulted in more frictional heat being generated on the aircraft skin, which may raise the internal ambient temperature considerably. Aircraft flying at heights of the order of 40,000 feet cannot use normal air-cooling methods to cool the electronic equipment, as the density of the air is so low that normal cooling fan systems have low efficiency. The development of guided weapons has also revealed new types of Service hazards for which testing is necessary.

During the compilation of testing schedules covering all Service equipments, climatic conditions and hazards likely to be encountered were the subject of considerable study, which was the result of joint effort by all the major Service establishments. The findings are presented in the Joint-Service Test Specification K.114 issued by the Radio Components Standardization Committee (Ministry of Supply).

The summaries contained in Tables I and II give information from the K.114 Specification on the climatic extremes and environments experienced in different parts of the world, and also conditions of mechanical shock, vibration and handling. These conditions represent Service hazards and the tests cover combinations of these conditions depending on the intended use of the equipment—shipborne, airborne, ground equipment, etc.

It is mandatory that all equipment for the services should be tested by one of the Service research and development establishments, and the K.114 series of test schedules have been designed to cover nine types of conditions which are summarized in Table III.

Table I

SERVICE CONDITIONS

CLIMATIC EXTREMES	
DESERT	Dry heat, intense sunlight, sand, dust, destructive insects. High day temperature { Air +60° C. / Ground exposed +75° C. Relative humidity 5% Low night temperature −10° C. Large daily variation in temperature, average 40° C.
TROPICAL	Damp heat, high relative humidity, heavy seasonal rainfall, mould growth, destructive insects. +40° C. during day, +25° C. during night. Exposed surfaces +70° C. Humidity can approach saturation.
ARCTIC	Low temperature, driving snow, icedust. Exposed Arctic −70° C. extreme, −40° C. common. Sub-arctic −25° C. common.
HIGH ALTITUDE	Low temperature, low pressure, condensation due to rapid changes in temperature. 30,000ft. 225 mm Hg −60° C. minimum. 60,000ft. 55 mm Hg −90° C. minimum. Allowances: 10° C. for fuselage protection. Above 30,000ft. 15° C. for adiabatic heating.
SEA	Sea spray, immersion. Air temperature extreme: +52° C, −40° C in harbour. +38° C., −32° C. at sea. Sea temperature extreme +29° C.

The value of initial testing before design approval is given to a Service equipment has been proved beyond doubt. During the past eight or nine years in which equipments have been tested to these stringent schedules, many faults have been exposed which would otherwise have occurred in service. "Pre-testing" results in improved reliability of equipments by exposing weaknesses and faults when there is still time to make modifications.

Testing equipment designed and installed at the various Service establishments is considerable, and ranges from simple dry heat ovens to large stratosphere chambers capable of testing complete equipments under all airborne conditions (low pressure, low temperature, etc.). A stratosphere chamber which is being installed at the Radar Research Establishment will have a working volume of 550 cu ft, and will cover the range +80°C to −75°C and altitudes up to 70,000 ft. At the same establishment a large precision vibration testing machine (up to 120 c/s) is in use, capable of dealing with equipments up to 500 lb in weight. The machine is mounted on a 55-ton block of concrete, which in turn is freely suspended on springs. This is done to preserve the sinusoidal vibration waveform.

Many attempts have been made to correlate the artificial test conditions with those experienced in various parts of the world, and recently an investigation was made into the drop in insulation resistance of components of various types exposed at the Tropical Testing Establishment in West Africa and in the humidity chambers at T.R.E. (now R.R.E.). Whilst it was difficult to assess the ratio in time between the two sets of conditions, it was obvious that the humidity chambers produced worse deterioration of components than actual conditions. This is illustrated by the graph (Fig. 1) showing insulation

* Radar Research Establishment. Ministry of Supply.

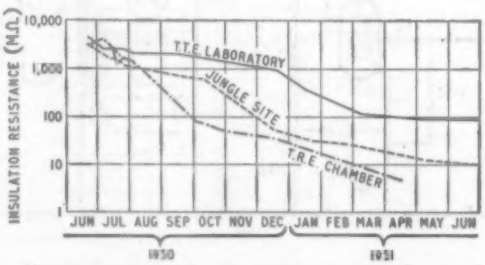


Fig. 1. Comparison of insulation resistance tests of sealed potentiometers under tropical and laboratory test conditions.

Table II

SERVICE CONDITIONS

MECHANICAL SHOCK, VIBRATION AND HANDLING

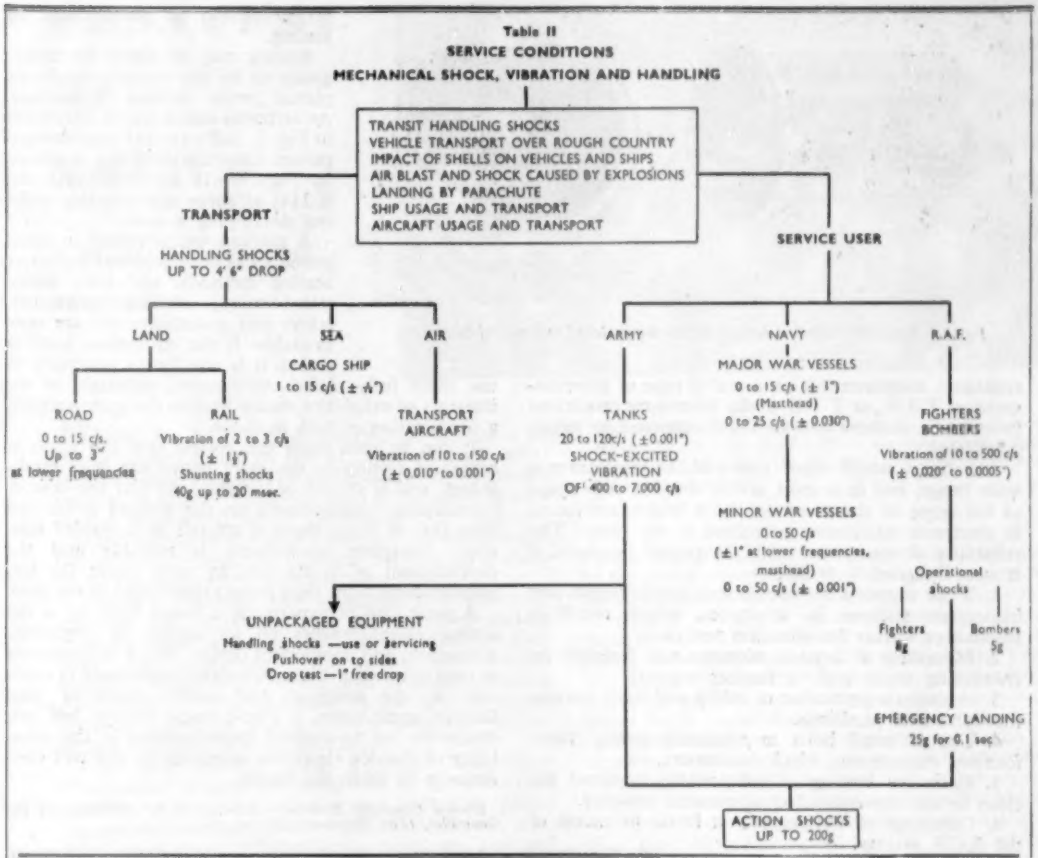
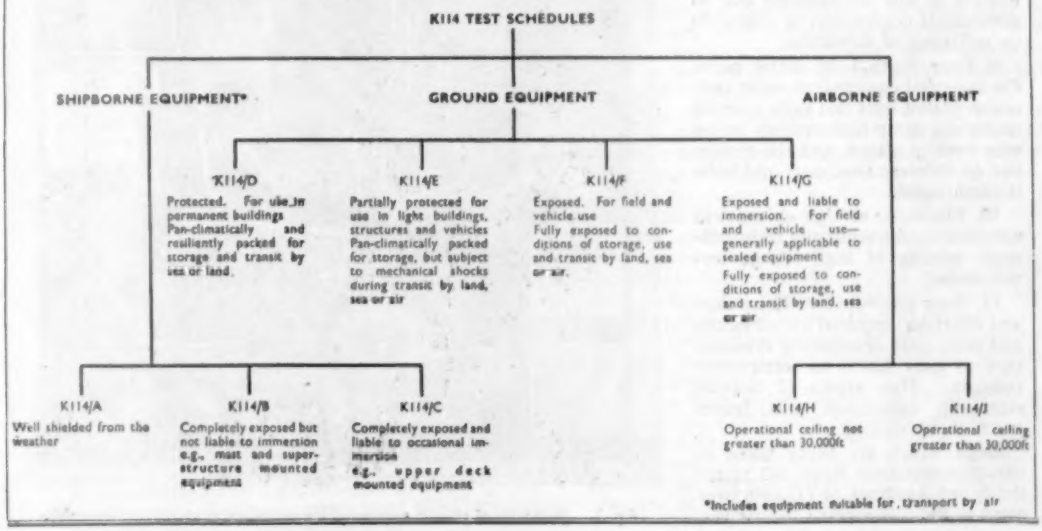


Table III

DESIGN ACCEPTANCE TESTS FOR SERVICE TELECOMMUNICATION EQUIPMENTS


K114 TEST SCHEDULES
SHIPBORNE EQUIPMENT*
GROUND EQUIPMENT
AIRBORNE EQUIPMENT
K114/D
Protected. For use in permanent buildings Pan-climatically and resiliently packed for storage and transit by sea or land.
K114/E
Partially protected for use in light buildings, structures and vehicles Pan-climatically packed for storage, but subject to mechanical shocks during transit by land, sea or air
K114/F
Exposed. For field and vehicle use Fully exposed to conditions of storage, use and transit by land, sea or air.
K114/G
Exposed and liable to immersion. For field and vehicle use—generally applicable to sealed equipment
Fully exposed to conditions of storage, use and transit by land, sea or air
K114/A
Well shielded from the weather
K114/B
Completely exposed but not liable to immersion e.g., mast and superstructure mounted equipment
K114/C
Completely exposed and liable to occasional immersion e.g., upper deck mounted equipment
K114/H
Operational ceiling not greater than 30,000ft
K114/J
Operational ceiling greater than 30,000ft

*Includes equipment suitable for transport by air

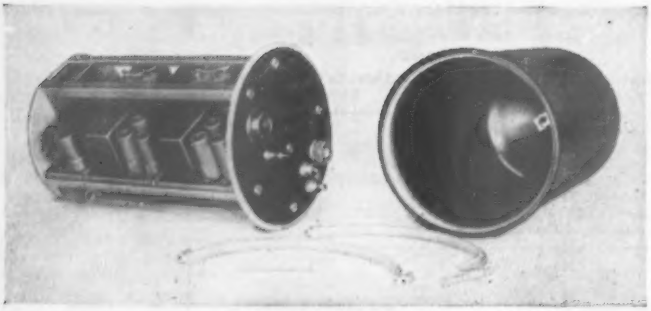


Fig. 2. Airborne electronic equipment totally enclosed in a sealed container.

resistance measurements on a sealed type of potentiometer at T.R.E., at T.T.E. under laboratory conditions (warehouse storage) and at T.T.E. exposed to jungle conditions.

The faults which occur under K.114 tests cover a wide range, and in a short article there is only space to list some of the common faults which are found in electronic equipment submitted to the tests. The reliability of equipment could be greatly increased if it were designed to avoid:—

1. Weak supports for component group boards and inadequate stiffness in structures, which result in resonances within the vibration test range.
2. Mounting of large condensers and resistors by connecting wires without further support.
3. Inadequate protection of cables and leads passing through metal partitions.
4. Use of small bolts in mounting heavy transformers, components, block condensers, etc.
5. Excessive heating of components mounted too close to vitreous-enamelled wirewound resistors.
6. Operation of components at levels in excess of the R.C.S. ratings.
7. Inadequate locking on screws, bolts and nuts.
8. Seizure of rotating mechanical devices at low temperature due to differential contraction of materials or stiffening of lubricants.
9. Poor finishes of metal parts. On unsealed equipments, most cadmium-plated nuts and bolts corrode under the damp heat cycling, unless very heavily plated, and the greater use of stainless steel nuts and bolts is encouraged.
10. Flashover at high altitudes in unsealed equipments due to insufficient spacing of high-voltage terminations.
11. Poor accessibility. Extra time and effort are required for servicing, and often part dismantling is necessary to gain access to some components. This aspect of Service electronic equipment still leaves much to be desired.

Steps which are being taken to reduce component faults fall under the broad headings of (1) improvement in the components themselves, (2) protection of components by sealing.

Sealing may be either by rubber gasket or by the recently developed plastic resin potting techniques. An airborne sealed unit is illustrated in Fig. 2, and a typical experimental potted sub-unit assembly is shown in Fig. 3. It has withstood the K.114J airborne test schedule without developing a fault.

A marked improvement in components has been achieved by better sealing methods, and fully sealed transformers, chokes, capacitors, relays and potentiometers are now available. If the equipment itself is sealed, it is not always necessary to use these fully sealed components, although, in the interests of reliability, many Service designers employ a combination of both methods.

It can be seen from this review that the value of extensive testing in the early stages has been established, and it should be emphasized that the cost of "pre-testing" equipments on the ground is far less than that of flying them in aircraft or in guided missiles. Complete surveillance is possible and the development of faults can be seen under far less arduous conditions than those experienced in the field.

A great deal of experience is being built up at the testing establishments on all aspects of electronic equipment and component design, and it is important to remember that this accumulated experience is available to the designers and manufacturers of new Service equipments. Pan-climatic testing has undoubtedly led to marked improvements in the reliability of Service electronic equipments, and will continue to do so in the future.

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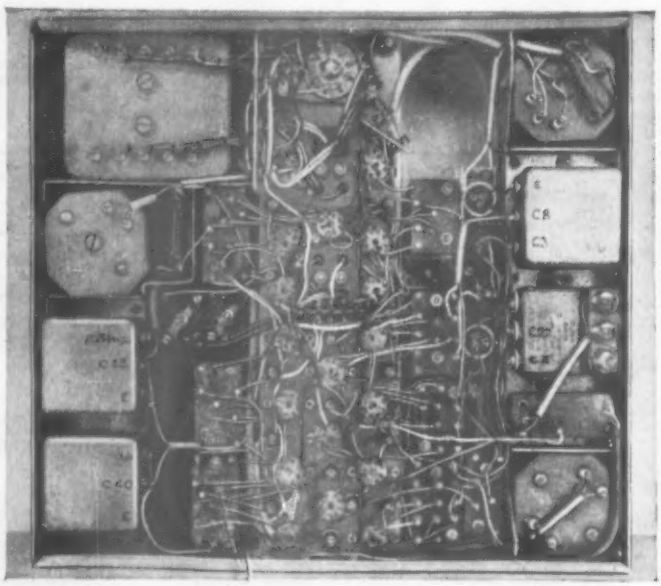


Fig. 3. Underside of chassis employing the technique of sealed sub-assemblies.

FESTIVAL OF SOUND

A Bold Experiment Succeeds

The trenchant commentary by G. A. Briggs was as much enjoyed by the audience of 3,000 as were the demonstrations of good sound reproduction and the "live" performances by well-known musicians.

WHEN G. A. Briggs announced his intention of taking the Royal Festival Hall in London for a lecture-demonstration on sound reproduction there was much shaking of heads. Could he hope to fill a hall with a seating capacity of 3,000? Would the vast size and acoustic clarity of the Hall prove too searching a test for equipment designed primarily to give an illusion of reality in domestic surroundings?

The first question was unambiguously answered when it was announced that all tickets—including those for standing room—had been sold within four days. Any misgivings on the second were quickly dispelled on the night, when, after listening critically and perhaps a little anxiously to the opening items, we were able to sit back and enjoy ourselves—as Mr. Briggs intended that we should.

For many of the items a single Wharfedale "3-speaker" system was used; two of these units, in parallel, were used for organ and orchestral pieces demanding a greater power output. A third unit, reinforced with extra high-frequency units, was reserved for demonstrations of effects which were primarily dependent on good h.f. response; in a hall of this size atmospheric absorption is a significant factor—at least for those in the back seats.

Pilot lamps showed the audience which loudspeaker(s) were in operation, and a visual power level indicator enabled all to see what was going in at any given moment. This instrument, devised by E. M. Price, M.Sc., consisted of a row of neon lamps arranged to strike in ascending order as the power increased from 3 to 60 watts. Viewing this meter from a seat in the stalls, one gained the impression that levels in excess of 15 watts were extremely rare. The whole of one organ piece (Allegro-Voluntary in D, by John Stanley) was accomplished within the 3-watt level. On the other hand, there were occasions, usually when one least expected it, when the power flicked up to the 60-watt level. To take care of the peaks, four of the Acoustical Manufacturing Company's "Quad II" amplifiers were connected in parallel.

Records were played on a Garrard Model 301 transcription turntable in which the speed control enabled exact equality of pitch to be found with the "live" performances with which comparisons were made. The pickup was a Ferranti ribbon type.

Tape records were made and reproduced by an E.M.I. Type BTR/2 professional machine.

All seats and standing room were filled long before 8 p.m.; thus, even before the proceedings were opened by the genial chairman, J. R. Tobin, B. Mus., we were already in debt to Mr. Briggs for showing us the strength of the public interest in good sound reproduction. With a disarming pretence of being non-technical, and with many bold sallies at the pundits Mr. Briggs quickly cut through the undergrowth of "hi fi" to get at the roots of good sound reproduction where art is more important than science; in particular the importance of microphone and studio technique to create the exact degree of "atmosphere," "ambience"—call it what you will—when replayed in given surroundings. It followed that his choice of orchestral recordings for demonstration in the Festival Hall carried a higher ratio of direct to reverberant sound than would be chosen for playback in a small room.

The acoustic level of reproduction relative to that of the original has a profound influence on balance and quality and must obviously be exact when direct comparisons with the original are made. For some of the items this yardstick was not available, but in all cases one felt that judgment in the choice of level was well informed.

The most courageous of Mr. Briggs' experiments —the immediate comparison of live performances by Stanislav Heller (harpsichord), Ralph Downes (organ) and Denis Matthews (pianoforte) with disc and tape recordings—proved to be the highlights of the evening. The delicacy and precision of the harpsichord playing, with every gradation of tone crystal clear in the recording made by C. E. Watts, were exactly matched in the impeccable playing of Stanislav Heller. The background noises in the Hall, which fell to a level creditable for an audience of three in a country cottage rather than 3,000 in the heart of London, was an even more eloquent comment than the applause which followed.

In the Bach organ Toccata in D we were able to compare an E.M.I. tape recording, made in the Festival Hall by Ralph Downes, with a live repetition of the same piece by the same player. In volume and quality the original and the reproduction were again exactly matched. By listening carefully the slightly

A study in concentration at one of the rehearsals. Facing the camera are G. A. Briggs (left) and P. J. Walker, who was responsible for the operation of the amplifier controls.

longer reverberation time of the recording was perceptible—proof that the Festival Hall really has got a hangover of sorts, if you go looking for it by successive recordings. This effect was absent in the harpsichord recording, which was made in accordance with the principle advocated by Watts of "no ambience" for solo instruments other than that of the space in which they are reproduced.

Unfortunately the piano available for Denis Matthews' playing of the Beethoven D minor sonata was not the one he used for the E.M.I. recording, so comparative analysis was given a holiday while we sat back and enjoyed two similarly realistic and virile examples of the pianist's art.

No live orchestra was available for comparison with the Decca l.p. recording (LXT2872) of the Beethoven 6th Symphony by the Concertgebouw orchestra under Erich Kleiber; but none was needed, for the inherent clarity and definition of all the parts was self-evident. The sight of an empty stage was the only incongruity. The string tone—wiry in some early l.p.s—was as near the real thing as the tone of one violin is to another.

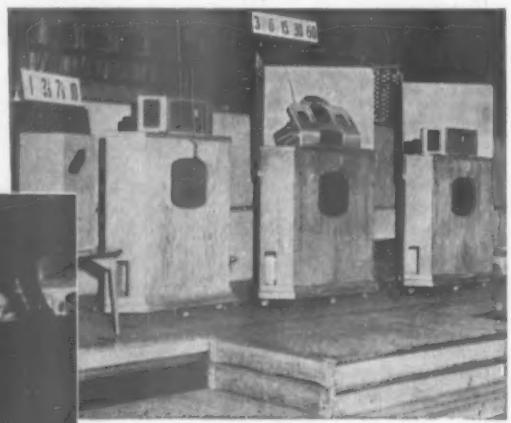
Those whose appetite for the classics is insatiable would have liked longer excerpts from many of the works, but that would have deprived others in the audience of a hearing of some remarkable sound effects, the records of which are themselves classics in their sphere. There was R. Bradford's recording of breaking glass, the B.B.C. recording of awe-inspiring reverberation effects in the Hamilton Mausoleum, the incisive tugboat engine-room noises captured by Mercury Sound Recordings, Ltd. and the W. S. Barrell collection of percussion instruments, with and without high frequencies (E.M.I. JGS74).

Mr. Briggs made some pithy comments on exaggerated claims for frequency response, particularly in the bass, and proved his point by having 32-c/s and 16-c/s notes played on the organ. The 32-c/s pure tone sounded useful, but most people would have needed a barometer to detect the 16-c/s. A 32-c/s reed pipe gave a plausible imitation of a loudspeaker with the coil off-centre.

The last item on the programme was the Vaughan Williams Sea Symphony (Decca LXT2907). A suggestion from Mr. Briggs that Ralph Downes should double the organ part was received in shocked silence by the musical purists, until Mr. Briggs fired a characteristic parting shot: "Well, if he plays as loudly as all the rest put together, we shall be only 3 db up—and what's 3 db among friends?"

On this note ended a most successful evening. The sound reproduction community owe a great debt to Mr. Briggs for his courage, vision and drive in staging this event. He in turn paid tribute to the help received from firms collaborating in the assembly of the equipment, to P. J. Walker for his sure handling of the amplifier controls, and to the recording companies for putting on disc and tape the high standard of quality which he was able to reproduce.

There was still much shaking of heads as the crowds left the Festival Hall, but it was noticeable that whereas six months ago the polarization was horizontal it had now changed to vertical.—F. L. D.



Original and reproduction. Denis Matthews alternates with the loudspeakers in a performance of a Beethoven piano sonata.

"BELLING-LEE" NOTES

Mobile Research Unit.

The "Belling-Lee" mobile research van is on the move again. Not that it has much idle time, it is here and there wherever a practical answer is required to a reception question sent in. Some little time ago it was in Edinburgh investigating rumours of "ghosts" round Salisbury Crags and Samsons Ribs. Then it will shortly be making a tour of the Midlands, investigating propagational phenomena on the experimental band III transmissions from Sutton Coldfield, i.e. very low power and square wave modulation only, i.e. no pictures. After that there is a programme of work on F.M. from Wrotham. We do believe that built-in aerials and those of the most elementary types will give a good signal at surprisingly long distances. We are anxious to study the transmissions to see at what range it will be necessary to change over to outside aerials, and to those of the "H" type or even the more elaborate horizontal Yagi arrays.

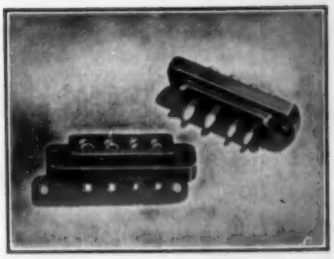
In the cases of band III and F.M., which of course is band II, we will pay particular attention to the effect of hills and dales, shadows and reflections and to all the finer points of reception we must know before we can give the public and the trade the quality of practical technical assistance to which they are accustomed when referring to "Belling-Lee."

Mast Head Pre-Amplifiers.

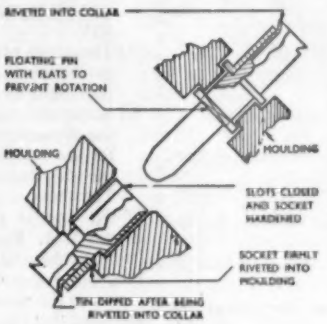
A week or so ago we were challenged as to why we did not redesign our mast head amplifier to utilise one of the new low-noise-factor valves in a high-gain R.F. double triode circuit. Others may be thinking along the same lines. The answer is very easy, the valve used by us is one of the "Trustworthy" series, and the only suitable valve of the series available. We believe these reliable valves to be the right kind to use in inaccessible places. We know of many "Belling-Lee" mast head amplifiers at the top of masts 75ft. in height, and we can just visualise the situation in the case of an early failure.

Advertisement of
BELLING & LEE LTD.
Great Cambridge Rd., Enfield, Middx.
Written 24th October, 1954.

Inter-unit connectors for 4 to 25 contacts

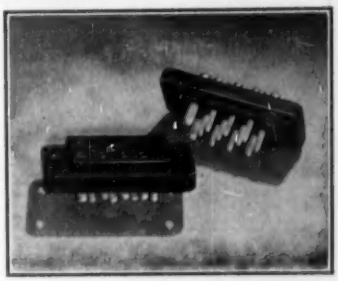


"UNITORS"


RIVETED INTO COLLAR
FLOATING PIN WITH FLATS TO PREVENT ROTATION
MOULDING
MOULDING
SLOTS CLOSED AND SOCKET HARDENED
SOCKET FIRMLY RIVETED INTO MOULDING
TIN DIPPED AFTER BEING RIVETED INTO COLLAR

LIST NO.	PINS	BODY SIZE
L.653/P&S	4	1.7/16" x 13/32"
L.654/P&S	8	1.31/64" x 37/64"
L.655/P&S	12	1½" x 27/32"
L.656/P&S	18	2" x 27/32"
L.657/P&S	25	1⅞" x 1.3/16"

Working volts: 500 V. Peak, pin to pin.



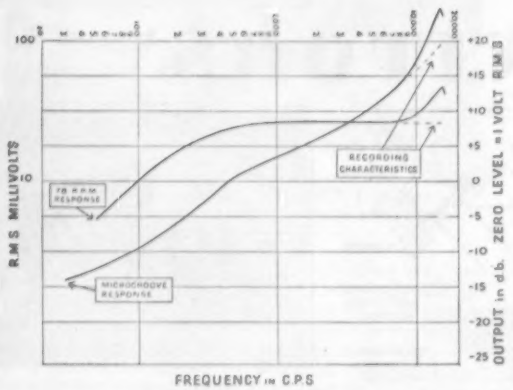
THIS popular range owes its origin to a very successful Government development contract, and Unitors are now widely used to facilitate the uncoupling of sub-assemblies for servicing or replacement. Each coupling consists of a block of plugs and one of sockets, arrayed so as to be non-reversible. Bodies are moisture and tracking-resistant, being moulded from a nylon-filled phenolic material. Pins are of high grade brass, sockets of differentially hardened beryllium copper, and both are hard gold-plated for improved shelf life, contact resistance, etc. Normal pins carry 3 amps, but each block has two larger pins carrying 10 amps each. All pins are fully floating, the method of assembly being covered by a patent. All plugs and sockets are numbered on both sides of the moulded body.

Die-cast light alloy covers for 'UNITORS' are now available

Unitors conform to R.C.S.321, and have A.I.D., A.R.B. and Joint Service approval.

BELLING & LEE LTD
GREAT CAMBRIDGE RD., ENFIELD, MIDDX., ENGLAND

PICK-UP DESIGN FOR HIGH FIDELITY RECORD REPRODUCTION



Frequency Response Curves of type 18 pick-up for 78 r.p.m. and Microgroove Records.

The increasingly high standard of present day recordings call for continuing developments in pick-up design. Long established principles still hold good, but design requirements are now much more exacting and require the application of precision engineering techniques. In the light of present knowledge the requirements for a high fidelity pick-up are:

(1) The frequency response should extend smoothly over the entire audible recorded range (30 c.p.s. to 15,000 c.p.s.).

(2) Distortion should be kept below the audibly detectable minimum. In this respect intermodulation measurements are probably the most significant, since they have the particular advantage that they are a direct measurement of the most objectionable form of distortion from the final listening point of view.
Possible causes of distortion in a pick-up which must be avoided are:
(i) Non-linearity arising either mechanically or electrically.
(ii) Undamped mechanical resonances outside the audible range, which can produce audible cross-modulation effects.
(iii) Sensitivity to pinch-effect.
(iv) Distortion of record material due to excessive mechanical impedance.

(3) Record wear must be kept to a negligible minimum. The movement of the pick-up must be highly compliant both vertically and horizontally and the playing weight must not cause distortion of the record material but must be sufficient to ensure continuous contact between stylus and groove walls at the maximum recordable modulation level.

(4) Long stylus life is necessary to avoid damage to records by rapidly worn styli and frequent changing of styli.

(5) The design must be stable to ensure maintenance of the performance specification both in production and in prolonged use.

(6) Sensitivity must be as high as possible consistent with the above in order to obtain the high signal/noise ratio for the complete reproducing equipment necessary for the wide dynamic range of modern recordings.

The above requirements are incorporated in the design of the type 18 pick-up used on "His Master's Voice" Model 3001. For performance consistency and freedom from mechanical resonances in the required frequency range, a magnetic system was chosen. Exhaustive experiments on the moving iron types of movement showed that provided that the reluctance of the return magnetic path is kept high and the signal flux in the armature is kept small compared with the saturation flux, then this type of movement possesses as linear a transfer characteristic as a corresponding moving coil design. The moving iron type was, therefore, chosen for its higher sensitivity and greater simplicity.

A cantilever stylus mounting with vertical axis of rotation has been used, since this effectively decouples the pick-up head from the stylus for vertical pinch effect movements and permits the use of a higher armature mass for a given effective inertia at the stylus point, thus reducing the signal flux density.

The material used for the suspension of the moving system in the pick-up was chosen for its stability and high mechanical resistance, stiffness ratio in order to ensure reliable and effective damping of the mechanical resonances outside the required frequency range.

For the long playing head a highly polished diamond stylus held to precise dimensional tolerances has been incorporated, since this is the only material which possesses sufficiently good wearing properties for extreme high fidelity reproduction of microgroove records. A sapphire stylus is used on the 78 r.p.m. head, since the larger tip radius used for these recordings together with the extremely low compliance of the pick-up movement result in adequately long life.

The features mentioned above and others combine to make the type 18 pick-up a reliable means of obtaining the full recorded quality from present day recordings and the best possible quality from old recordings.

"HIS MASTER'S VOICE"

THE GRAMOPHONE COMPANY LIMITED · HAYES · MIDDLESEX

Filters Without Fears

4—*Make Your Mathematics Multi-purpose*

By THOMAS RODDAM

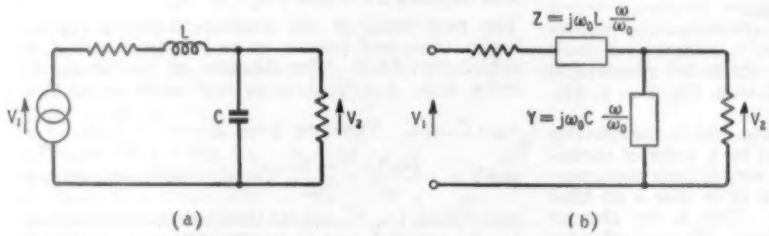
ONE of the main defects of formal education is that everything has to be made up into neat packets. This is history, that is geography and that rather grubby subject is science: if someone invents a steam engine on an island, it isn't anyone's business to point out that what has really happened is a sharp change in the movement of history. In our own special field we begin by making the same mistake: we chop up telecommunications into a number of special plots, and these we then subdivide again. If you look in the textbooks you will see a a chapter on low-pass filters, a chapter on high-pass filters; a chapter on band-pass filters and a quick mention of band-stop filters. This arrangement is both unnecessary and unwise.

The three previous articles have been concerned with the algebraic design of low-pass filters. For the forgetful, the procedure has been to take a simple network made up of series inductance and shunt capacitance elements connected between a resistive generator and a resistive load, to calculate by means of Kirchhoff's laws, or any other method, the ratio of generator voltage to load voltage, and then to do some simple algebra. We find that $V_{in}/V_{out}=A+jB$, we convert to $|V_{in}/V_{out}|^2=A^2+B^2$ and for the networks we have considered $|V_{in}/V_{out}|=a+b\omega^2+c\omega^4$. This is the frequency response of the network, and we have then considered two special forms that this polynomial can take. The result is to give us a number of equations which can be solved to provide, in the end, the values of inductance and capacitance needed for a specified frequency response. The more complicated the response (for example a Tchebycheff response with ripples instead of a smooth Butterworth response) the more complicated the equations.

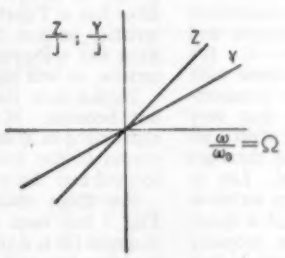
We could now start off again, and repeat the whole process for high-pass and band-pass filters. This method is possible, it is tedious and it is completely unnecessary.

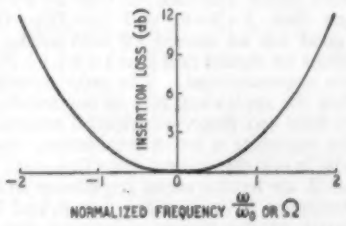
Let us look at a second-order low-pass filter, shown in Fig. 1(a). We can draw this in a rather more general way by using the form shown in Fig. 1(b), in which the series arm is now a box mounted with its impedance, $Z=j\omega_0 L.\ \omega/\omega_0$, and the shunt arm is a box marked with its admittance, $Y=j\omega_0 C.\omega/\omega_0$. There are two points to notice here. The first is the choice of impedance for the series arm and admittance for the shunt arm: this is to enable us to draw graphs of these functions easily. It is a general rule that if you can choose your relationships to make your graphs straight lines you should. The second point is that instead of writing $j\omega L$, I have written $j\omega_0 L.\omega/\omega_0$: this is the usual normalizing process, the process of making one graph do the work of many. All the responses we have seen in the previous articles have been normalized responses.

Fig. 2(a) shows the impedance and admittance functions, $j\omega_0 L.\ \omega/\omega_0$ and $j\omega_0 C.\omega/\omega_0$ plotted as functions of ω/ω_0. If you don't ask what is meant by a negative frequency there is no reason why the two straight lines in the top right-hand quadrant should not be projected back through the origin into the bottom left-hand quadrant. Similarly we can draw Fig. 2(b), the insertion loss characteristic, but this time on a linear scale including negative frequencies. I've



Above: Fig 1. The second-order low-pass filter (a) can be drawn in a more formal way by inserting impedance and admittance "boxes" as in (b).





Right: Fig. 2. The impedance and admittance characteristics of (a) lead to the insertion loss characteristic (b). Note that a linear frequency scale is used here.

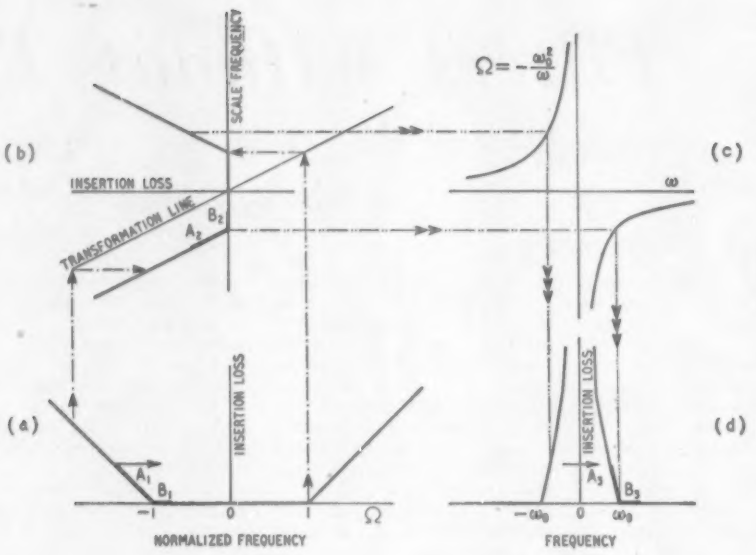
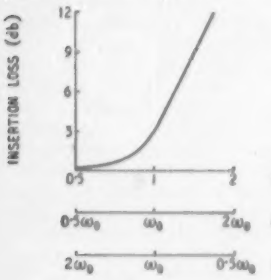


Fig. 3. The transformation of low-pass to high-pass takes us from A_1 (a), up to the transformation line and then along to A_2 (b). Then we go across to the transformation curve (c), and down to (d). The transformation is of frequency only: the insertion loss just goes straight across.

Below: Fig. 4. For the high-pass case, we need only reverse the scales in a logarithmic frequency plot.



chosen the Butterworth shape because it is easier to draw, and since we have

$$\text{Insertion loss} = 10 \log \left[1+\left(\frac{\omega}{\omega_0}\right)^4\right]$$

the insertion loss at any negative frequency $-\omega$ is exactly the same as at the corresponding positive frequency ω, and the response is symmetrical about the insertion loss axis. Similarly symmetrical Tchebycheff responses were given in Fig. 2 on p. 446, September, 1954 issue.

We got from the circuits of Fig. 1(b) to the insertion loss characteristics of Fig. 2(b) by a series of mathematical manœuvres. There is a very difficult mathematical step, so difficult that most of us take it on trust and never really question it. This is the abstract truth of a mathematical equation. We start off quite happily with the idea that 2 apples + 3 apples = 5 apples. This is followed up by a series of confidence tricks which convince us that $2+3=5$, always, and then that $2\times3=6$, and $(x+1)(x-1)=x^3-1$.. It's a good job we started off with apples, because with rabbits we should find that $1+1=1+e^{j\pi}$ was a reasonable approximation. The only trouble is that very often the apples still lurk in our minds, the equations are held too firmly to physical reality, and then we give ourselves a lot of unnecessary trouble. Let us write in our discussions above $\Omega=\omega/\omega_0$. Then we know that if we have a series impedance $j\mathrm{A}\Omega$ and a shunt admittance $j\mathrm{B}\Omega$, provided that A and B are properly related to the circuit resistances the insertion loss will be small for $-1<\Omega<1$ and large for $|\Omega|>1$.

Note that Ω does not have to be any particular kind of thing: since it had, at its first appearance, the dimensions (frequency/frequency) there is no dimensional limitation. So long as Z and Y are proportional to Ω we get the filter type insertion loss characteristic.

As a special case, we can take $\Omega=\omega/\omega_0$. Then, as we know, we get a low-pass filter. Suppose, however, we take $\Omega=-\omega_0/\omega$. If we look at some special values of Ω, $\Omega=0, \pm1$ and $\pm\infty$ we see that

$\Omega=-\infty$	-1	0	$+1$	$+\infty$
$\omega=0$	ω_0	$\pm\infty$	$-\omega_0$	0

The stop band of the insertion loss characteristic, which we can take as roughly the region $|\Omega|>1$ (the transistion region can be forgotten for the moment) now becomes the region $-\omega_0<\omega<\omega_0$.

The pass band, in the positive frequency region, begins at ω_0 and extends up to infinity: the filter is a high-pass filter. The elements of this filter are: series arm, $Z=-j\omega_0\mathrm{L}.\omega_0/\omega$, and shunt arm, $Y=-j\omega_0\mathrm{C}.\omega_0/\omega$. Thus we have $Z=-\dfrac{j\omega_0^2\mathrm{L}}{\omega}=\dfrac{\omega_0^2\mathrm{L}}{j\omega}$ and $Y=\dfrac{j\omega_0^2\mathrm{C}}{\omega}=\dfrac{\omega_0^2\mathrm{C}}{j\omega}$. The series arm is therefore a capacitance, $1/\omega_0^2\mathrm{L}$, and the shunt arm is an inductance $1/\omega_0^2\mathrm{C}$, where L and C are the values we calculated from our basic low-pass theory. If the low-pass filter has a Tchebycheff type of insertion loss characteristic, so has the high-pass filter: if the low-pass filter has a Butterworth type of insertion loss characteristic, so will high-pass filter.

Notice how useful that negative frequency region has become. We must use $\Omega=-\omega_0/\omega$ to get the signs right in Z and Y, and it is the negative frequency region of the low-pass characteristic which is transformed into the positive region of the high-pass.

For those readers who like a geometrical picture, Fig. 3 has been constructed. The bottom left-hand diagram (a) is a simplified filter characteristic, showing insertion loss as a function of the normalized frequency Ω. First of all we do a scale transformation, to give us the response shown in (b). The scale transformation

is just a way of altering the size of the diagram, and twisting it through a right angle. From each point on the characteristic in (a) we move vertically until we hit the transformation line, giving us our position on the "scale frequency" axis. Then we mark off the same insertion loss as we have in (a), to get a diagram of insertion loss against scale frequency. If we make the slope of the transformation line 45° the scale frequency will be the same as the normalized frequency: any other slope opens out or closes up the frequency scale. Now we move across from points in the characteristics in (b) to the main transformation curve (c). This, which is the form used for the low-pass to high-pass transformation, must be of the kind $\Omega = k/\omega$, where k includes ω_0 and the slope of the transformation line. You need not worry about that k, because it is really put in just to enable us to write the actual frequency in our final characteristic. We go across from (b) to (c), and then down to (d). To make it easier to draw, I have not traced out the path of a single point, but you can, if you wish, follow the section A_1B_1 to A_2B_2 and then on to A_3B_3. The corner of this section, which is at $\Omega = -1$ in (a), is at $\omega = \omega_0$ in (d) (that's what we use the k for).

I have drawn this transformation process for a rather simple and unreal filter characteristic. Obviously it can be done for any complicated real characteristic, and point by point you can build up the high-pass filter obtained by changing all the inductances to capacitances of size $1/\omega_0^2 L$ and all the capacitances to inductances of size $1/\omega_0^2 C$. To do this, of course, you must use a linear scale for Ω.

You may think this is a long way round for the high-pass filter. It is. As you can see from Fig. 4, if we have our response plotted on a logarithmic scale we need only number it from right to left instead of left to right to obtain the corresponding high-pass response. Why, then, all this complication of Fig. 3?

The answer is, of course, that this is a general process of very much wider application. Instead of taking $\Omega = -\omega_0/\omega$, let us now take $\Omega = \frac{\omega_m}{\omega_0}\left(\frac{\omega}{\omega_m} - \frac{\omega_m}{\omega}\right)$

This function is plotted in Fig. 5(c), and the transformation construction is carried through again. To save effort, the transformation line in Fig. 5(b) is at 45°, so that Fig. 5(b) is the same as Fig. 5(a), but sideways. The transformation curve of Fig. 5(c) has two branches, both of which must be used. The result is the response shown in Fig. 5(d), a band-pass characteristic. Notice here that the single pass-band of the low-pass filter from $-\omega_0$ to $+\omega_0$ has been transformed into two pass-bands, one centred on ω_m and one centred on $-\omega_m$. Normally, of course, we only worry about one of these, the one centred on $+\omega_m$ but the existence of the other is of some theoretical importance. It accounts for certain oddities of behaviour, such as the lack of symmetry of the band-pass characteristic.

Geometrical exercises are all very well, but what use are they? Here we have written $\Omega = \frac{\omega_m}{\omega_0}\left(\frac{\omega}{\omega_m} - \frac{\omega_m}{\omega}\right)$. The series arm of the filter, then, is an impedance

$$Z = j\omega_0 L.\Omega = j\omega_0 L.\frac{\omega_m}{\omega_0}\left(\frac{\omega}{\omega_m} - \frac{\omega_m}{\omega}\right) = j\omega_m L.\frac{\omega^2/\omega_m^2 - 1}{\omega/\omega_m}$$

This impedance can be recognised as the impedance of an inductance L_1 and a capacitance C_1 in series, with $\omega_m^2 L_1 C_1 = 1$. The change from L, C, to L_1, C_1 is made, so that we shall not get confused with the capacitance in the shunt arm.

$$Z = j\omega L_1 + \frac{1}{j\omega C_1} = \frac{1-\omega^2 L_1 C_1}{j\omega C_1} = j\omega\, L_1 \frac{\omega^2 L_1 C_1 - 1}{\omega^2 L_1 C_1}$$
$$= j\omega_m L_1 \frac{\omega^2/\omega_m^2 - 1}{\omega/\omega_m}.$$

In the same way, the admittance of the shunt arm, $Y = j\omega_0 C.\Omega$ is the admittance of a capacitance C_2 tuned to ω_m by a parallel inductance L_2.

We have made the transformation $\Omega = \frac{\omega_m}{\omega_0}\left(\frac{\omega}{\omega_m} - \frac{\omega_m}{\omega}\right)$ and we want to know more about this. We have

$$\Omega = \frac{\omega_m}{\omega_0} \cdot \frac{\omega^2 - \omega_m^2}{\omega\omega_m} = \frac{\omega^2 - \omega_m^2}{\omega\omega_0} = \frac{(\omega+\omega_m)(\omega-\omega_m)}{\omega\omega_0}$$

The band edges, as we can see from Fig. 5, correspond to $\Omega = \pm 1$. What does this mean in terms of ω? Suppose we have a narrow-band filter, first of all. Then $\omega \approx \omega_m$ in the band, and we can write $(\omega + \omega_m) \approx 2\omega$. This makes

$$\Omega = \frac{2\omega(\omega - \omega_m)}{\omega\omega_0} = \frac{2}{\omega_0}.(\omega - \omega_m).$$

For $\Omega = \pm 1$ this means that $\omega = \omega_m \pm \omega_0/2$. The band-width of the band-pass filter is ω_0, the band-width (in the positive frequency direction) of the low-pass filter from which we started. The reason why we get this halving is that there is a second

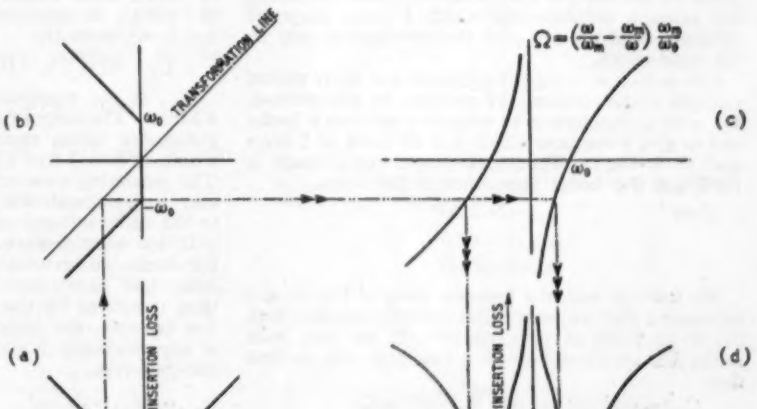


Fig. 5. With the curve shown in (c), the low-pass filter transforms into a band-pass filter.

pass-band in the negative frequency region: the total pass-band width is the same for the low-pass and band-pass filters if we watch all the pass-bands.

It may not be immediately obvious what has happened. Suppose we want to design a band-pass filter of band-width B, centred on some frequency F. First we design the low-pass filter which has a cut-off at a frequency B, then we tune all the inductances with series capacitances to the centre frequency F, and all the capacitances with parallel inductances to the same centre frequency F. Provided that B/F is small, the filter will have the wanted response, and according to our choice of shape for the low-pass circuit, so the band-pass filter will be Tchebycheff or Butterworth or what you will.

When B/F is not small, we must determine ω_o, the design characteristic for the low-pass filter, more carefully. We know that $\Omega=\pm 1$ represent the values of the transformation function at $\omega=\pm\omega_o$ in the low-pass circuit. Let us call the upper characteristic frequency of the band-pass filter ω_{c2}, and the lower characteristic ω_{c1}. We can then write

$$\Omega=1 \text{ at } \frac{\omega_m}{\omega_o}\cdot\frac{\omega_{c2}^2-\omega_m^2}{\omega_{c2}\omega_m}$$

and

$$\Omega=-1 \text{ at } \frac{\omega_m}{\omega_o}\cdot\frac{\omega_{c1}^2-\omega_m^2}{\omega_{c1}\omega_m}$$

This leads us to

$$\frac{\omega_{c2}^2-\omega_m^2}{\omega_{c2}\omega_m}=\frac{\omega_m^2-\omega_{c1}^2}{\omega_{c1}\omega_m}$$

$$\omega_{c1}\omega_{c2}^2-\omega_{c1}\omega_m^2=\omega_{c2}\omega_m^2-\omega_{c2}\omega_{c1}^2$$

or

$$(\omega_{c1}+\omega_{c2})\omega_{c1}\omega_{c2}=(\omega_{c1}+\omega_{c2})\omega_m^2$$

$$\omega_{c1}\omega_{c2}=\omega_m^2$$

Thus ω_m is the geometric band centre.

Now we can work the geometrical construction backwards, because we know what ω_m is to be. Alternatively, we know that from the equation $\Omega=1$,

$$\omega_o=\frac{\omega_{c2}^2-\omega_m^2}{\omega_{c2}}=\frac{\omega_{c2}^2-\omega_{c1}\omega_{c2}}{\omega_{c2}}=\omega_{c2}-\omega_{c1}$$

Much to our surprise, this complicated transformation leaves the band-width completely unaltered. Thus for any ratio of band-width to centre frequency, the primary elements—by which I mean those we calculate from the low-pass theory—depend only on the band-width.

Let us look at a slightly synthetic but fairly typical example of the problems we can solve by this method. We want a transformer to connect a valve to a feeder and to give a response which is 3 db down at 2 Mc/s and at 8 Mc/s. The valve output capacitance is 10pF and the feeder impedance is 100 ohms.

Then
$$\omega_{c1}=2\pi.2.10^6$$
$$\omega_{c2}=2\pi.8.10^6$$
$$\omega_m=2\pi.4.10^6$$

We start off with the low-pass filter of Fig. 6, and we assume that we want a Butterworth response with the 3 db point at $\omega_o=2\pi.6.10^6$. If we turn back to the first article and take $k'=1$ on page 369, we find that

$$C(_2)=\sqrt{2}/\omega_o R_2 \text{ so that } R_2=\sqrt{2}/\omega_o C$$

This gives us $R_2=\sqrt{2}/2\pi.6.10^6.10.10^{-12}$ putting in the values for C_2 and ω_o already chosen. Thus $R_2=4{,}100$ ohms.

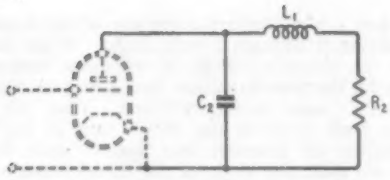
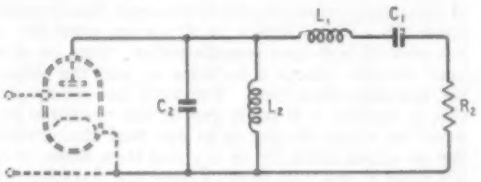
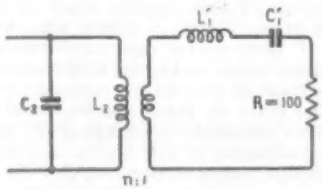


Fig. 6. In designing an output transformer we begin with this low-pass circuit.



(a)



(b)

Fig. 7. The conversion to band-pass leaves C_2 and L_1 unaltered from Fig. 6 (a), but we introduce the transformer as shown in (b).

L_1 we could calculate from the equation $\omega_o^2LC=1$. We shall not do this, though, because we can avoid one step by adopting a different order. We convert Fig. 6 to a band-pass filter by adding L_2 and C_1, producing two tuned circuits, both tuned to 4 Mc/s. We want to work into an impedance of 100 ohms, so now we convert to the circuit shown in Fig. 7(b), in which L_2 is the primary of a transformer, the ratio of which must clearly be $(4{,}100/100)^{\frac{1}{2}}:1$ or $6.4:1$. We put L_1 on the secondary side, and from the first article we know that

$$L_1'=R2/\sqrt{2}\omega_o=100/\sqrt{2.2}\pi.6.10^6=1.87\mu H.$$

C_1', is the capacitance which tunes 1.87 μH tc 4 Mc/s. The output transformer, then, has a primary inductance which resonates at 4 Mc/s with 10pF, a ratio of 6.4 : 1 and a leakage inductance of 1.87μH. The remaining numbers are easily calculated. With such a transformer we present a load of 4,100 ohms to the valve at band centre.

If we want to know any other characteristics of the circuit, we can work them out for the low-frequency case, plot the result as a function of Ω and then transform by the geometric method of Fig. 5. For example, the impedance presented to the valve at any frequency is obtained by calculating, for the low-pass case,

$$Z=\left(j\omega C+\frac{1}{j\omega L+R_2}\right)^{-1}$$
$$=\frac{j\omega L+R_2}{1-\omega^2LC+j\omega CR_2}=R_2\frac{1+j\Omega\sqrt{\frac{1}{2}}}{1-\Omega^2+j\Omega\sqrt{2}}$$

Then we can plot the impedance as a function of Ω, and transform the resulting curves by the method of Fig. 5.

We really need no more transformations, for our simple analysis, because if we first convert from low-pass to high-pass, and then carry out the transformation which gave us the band-pass filter, we shall obtain a band-stop filter. Only rarely do we want a band-stop filter, however, and I do not think we should trouble too much about it.

Having come to this point, let us look back and see what we have managed to do. We have seen that filters can be designed without any special concepts, such as image attenuation constants or characteristic impedance: we have seen how exact responses can be selected and the choice which is presented to us. All this, using ordinary simple algebra, we work out in terms of low-pass filters. Now we have shown that the whole of the low-pass analysis can be used, lock, stock and barrel, to solve our high-pass and band-pass problems. By two successive operations, the band-stop filter can be handled without introducing a new transformation. Similarly, if the band-pass filter is re-passed through the transformation of Fig. 5, we shall have designed a filter with two pass-bands. It is, of course, the ordinary band-pass case which is of the greatest importance, and it is here that the method is of special value, because a direct approach involves such very cumbersome algebraic expressions.

An interesting example of the power of this method of attacking the band-pass filter will serve as a tail-piece. When we make the system of Fig. 7(b), what happens if the two circuits are not tuned to the same frequency? If we transform the impedance and admittance of Fig. 2(a) to the band-pass form, we see that they should both look like the curve of Fig. 8(a). Suppose, however, that one is tuned slightly above f_m, and the other slightly below. The result is shown in Fig. 8(b) as an approximation; when we transform this back to the low-pass case, we have $\frac{Z}{j}=(\omega+\delta\omega)L$ and $\frac{Y}{j}=(\omega-\delta\omega)C$, assuming that the two circuits are detuned by equal amounts above and below the correct value (this may imply a new definition of ω_m).

The insertion loss coefficient can be obtained by writing $j(\omega+\delta\omega)L$ in place of $j\omega L$ and $j(\omega-\delta\omega)C$ in place of $j\omega C$ in the equations previously derived. We had

$$N=1+j\omega\left(CR_g+\frac{L}{R_g}\right)-\omega^2LC,$$

for the special case of $R_1=\infty$, $k'=1$ and $R_g=\infty$ so that $N=1+j\omega CR_g-\omega^2LC$

Now we put in the modified forms, to get

$N'=1+j(\omega-\delta\omega)CR_g-(\omega+\delta\omega)(\omega-\delta\omega)LC.$

$=1-\omega^2LC+j(\omega-\delta\omega)CR_g$ if $(\delta\omega)^2$ can be neglected.

$|N'|^2=1+\omega^2(C^2R_g^2-2LC)+\omega^4L^2C^2-2\omega\delta\omega CR_g$

For a Butterworth response we put $(C^2R_g^2-2LC)=0$ and this now gives us

$|N'|^2=1+\omega^4L^2C^2-2\omega\delta\omega CR_g$

Now $CR_g=\sqrt{2}/\omega_0$, so that

$$|N'|^2=1+\omega^4L^2C^2-2\sqrt{2}\delta\omega.\frac{\omega}{\omega_0}$$

$=(1+\Omega^4)-2\sqrt{2}\delta\omega.\Omega$

The term $(1+\Omega^4)$ is just the usual Butterworth response, while $-2\sqrt{2}.\delta\omega.\Omega$ is the perturbation due to the mistuning. As you can see, with the approximations and assumptions we have made, the perturbation is proportional to Ω.

The whole response has thus acquired a tilt, something on the lines of Fig. 9, and across the full band our approximations have led us to a uniform slope to be added to the Butterworth curve. When we transform to the band-pass case, the whole positive and negative low-pass response is used, and now it is important to remember this, because it is no longer symmetrical.

How large is the effect? Let us now look back at the example we discussed earlier of a band-pass output transformer where we could expect the valve capacitance, nominally 10pF, to have a tolerance of $\pm$1pF. Suppose that it is actually 10pF$-$1pF. The series tuned circuit is unaffected, so that if we want to use our simple approximation above we must first shift our reference frequency up a little, so that the two circuits are equally detuned on either side of the reference frequency. The capacitance error at the valve anode will then be halved, to 0.5pF. From this, the value of $\delta\omega$ in the normalized low-pass case will be about 1/40, so that at the band edges, where $\Omega=\pm1$, the response will be

$10\log 2\pm 2\sqrt{2}/40$db

$=10\log 2\pm 0.07$db

$=3.15$db and 2.85db.

There is nothing to prevent our carrying out the same calculation for a third-order Tchebycheff filter: nothing, that is, except laziness. All the processes we have considered in this article are applicable over a very much wider field than that I have tried to cover. There is still a trace of the original apple in our analysis. But this set of articles, now at an end, has been intended only to describe the methods which you can use to understand filters.

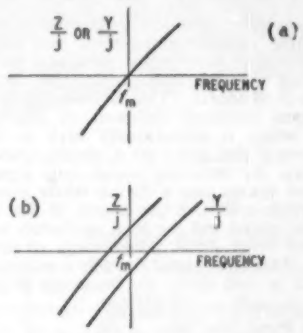


Fig. 8. (a) For a band-pass filter, both circuits should tune to f_m. Errors in alignment may cause one to be slightly low, and one slightly high (b).

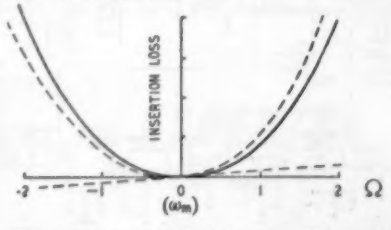


Fig. 9. The effect of mistuning is to put a linear tilt on the curve, as well as shifting it sideways.

COLOUR COMPLICATIONS

Additional Circuitry Required for Television Receivers

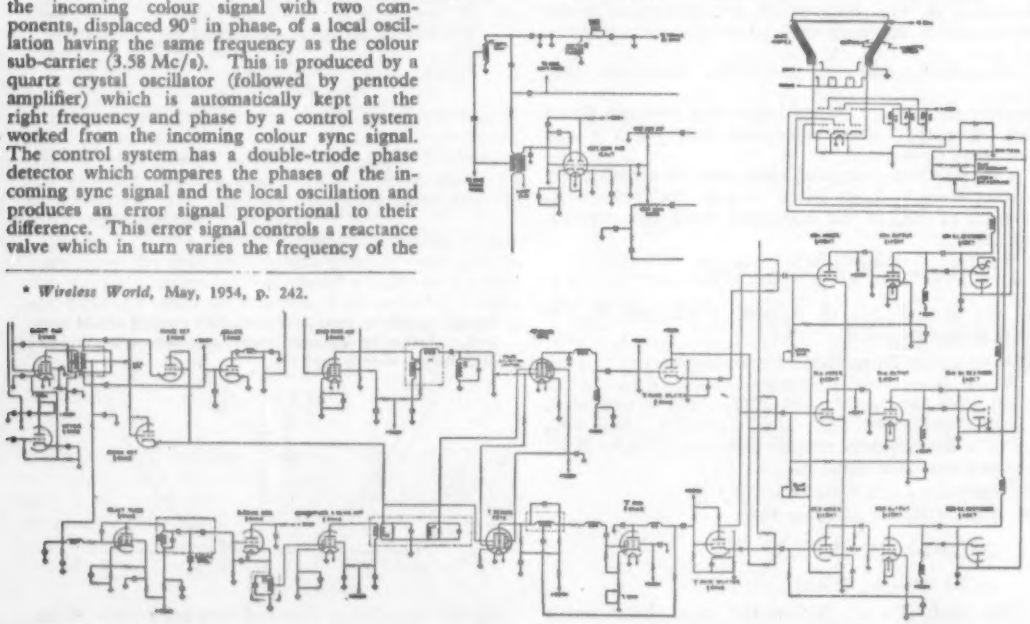
THE diagram below gives some idea of the type of receiver circuitry we would have to cope with if colour television came to Britain—that is, colour television based on the N.T.S.C. compatible system. It shows not a complete receiver, but simply the additional circuits required to enable colour information to be received and displayed. The receiver in question is actually the first commercial colour set to be produced by R.C.A.—the model CT-100. It uses 37 valves, two metal rectifiers and three crystal diodes. Just over half of these are in the standard parts of the circuit, which are much the same as an ordinary black-and-white receiver. The front end consists of a u.h.f.-v.h.f. turret tuner, while the pictures are displayed on a tri-colour c.r. tube (type 15GP22)* with a diagonal of about 12½ inches.

Separation of colour information from the complete video signal is done by a pentode band-pass amplifier with a pass band of 2.4-5 Mc/s. In the absence of colour information (a normal black-and-white transmission) this amplifier is cut off automatically by a triode gating circuit operated from the colour sync signal. The separated colour signal is passed to two synchronous detector stages (heptodes), and these demodulate the two colour-difference signals (which, at the transmitting end, are modulated on to two components of a sub-carrier displaced 90° in phase).

The synchronous detection is achieved by heterodyning the incoming colour signal with two components, displaced 90° in phase, of a local oscillation having the same frequency as the colour sub-carrier (3.58 Mc/s). This is produced by a quartz crystal oscillator (followed by pentode amplifier) which is automatically kept at the right frequency and phase by a control system worked from the incoming colour sync signal. The control system has a double-triode phase detector which compares the phases of the incoming sync signal and the local oscillation and produces an error signal proportional to their difference. This error signal controls a reactance valve which in turn varies the frequency of the local oscillator until the error is reduced to zero. A triode gating circuit is used to select the colour sync signal from the rest of the video waveform.

Returning to the two demodulated colour-difference signals, each of these is now passed to a triode phase-splitter and this produces positive and negative outputs suitable for the adding circuits, which come next. The adding circuits consist of three resistance networks, each followed by a triode. Here, suitable proportions of the colour-difference signals and the brightness signal (from the black-and-white section) are combined to produce three outputs corresponding to the red, blue and green components of the original picture. These are amplified by three output triodes, then d.c. restored by three diodes and finally applied to the three grids of the tri-colour tube.

There is also a double-triode circuit directly associated with the tri-colour tube itself. This modulates the d.c. potentials on the focus and convergence electrodes so that the electron beams are always kept properly converged and focused on the perforated mask wherever they are moved across it by the scanning system. Without this the beams would not pass through all the holes in the mask correctly and fall on the appropriate coloured phosphor dots on the screen.



(Courtesy RCA Review)

* *Wireless World*, May, 1954, p. 242.

Colour Television Valves

THREE new valves, specially designed for colour television, are used in the colour channel of the CT-100.

6AN8, a miniature pentode plus triode. The pentode section is used as a video amplifier or as a reactance valve while the triode performs variously as a phase detector, gating valve, oscillator and phase splitter.

6BY6, a miniature heptode. This is used as a synchronous detector, and the local oscillation from a separate source is applied to g, (the second control grid).

6BC7, a miniature triple diode. This provides the three d.c. restorers used on the red, blue and green colour-component signals immediately before they are applied to the tri-colour c.r. tube.

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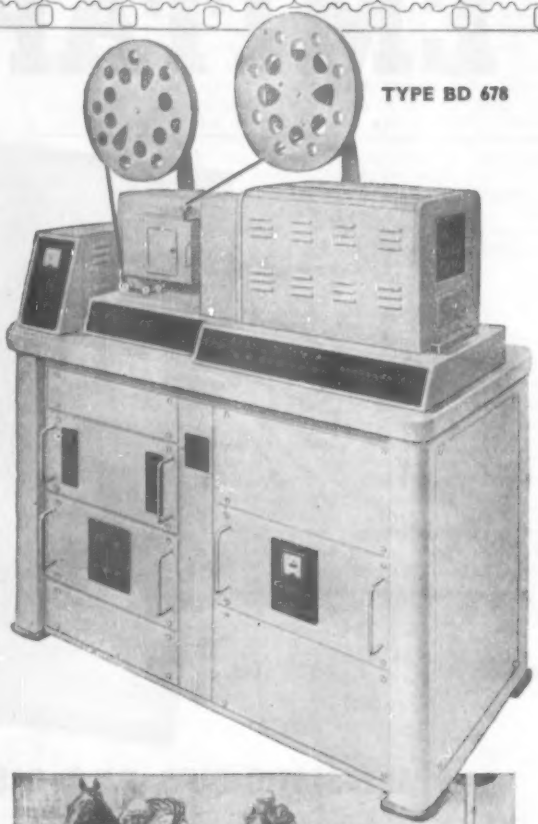

TYPE BD 678

The equipment provides a television picture of exceptionally high quality from 16 mm. films and 2 x 2 in. miniature film slides. A 'fast pull down' type of film projector is used and a similar mechanism serves for television systems having field repetition rates of either 50 or 60 fields per second. Thus any type of fixed or moving prism system is obviated.

The 16 mm. Projector, Turret Slide Scanner, Optical Change-over Assembly, Flying Spot Scanning Unit and the PEC Amplifier are mounted on top of the steel cabinet which houses the auxiliary units and power units.

The equipment can be fully controlled locally and remote controlled for stopping and starting of the film projector, change-over from film to slides and selection of any one of eight slides.

Editions of the BD 678 are available for 405, 525, or 625 line systems

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LB 2

Feedback I.F. Amplifiers for Television

By H. S. JEWITT,* B.Sc. (Eng.)

Experimental Design Offering Simplicity of Alignment

LAST February this journal published an article† giving details of a feedback technique for obtaining wide bandwidths in i.f. amplifiers. No specific application was discussed, but, in view of the simplification claimed to result from the use of this technique, the possibility of its application to television receivers has now been investigated. The present article is concerned with current television receivers of about 3 Mc/s bandwidth, but, as was clear from the previous article, the technique is likely to be of even greater value if wide-band colour television comes into use some time in the future (see page 625).

The television receiver presents a special problem for study, with requirements not met in other design fields. The first of these is the need for adequate sound rejection, which demands a trough in the response curve at sound frequency giving about 30-40 db of attenuation. This rejection may be provided by sound traps, or by designing the vision amplifier so that the response curve falls so sharply on the sound side that, although the highest vision frequency is passed satisfactorily, the sound carrier 0.5 Mc/s from this frequency is attenuated by the required 30-40 db.

The second special requirement has been introduced by the opening of new transmitters to give national coverage. This has filled the allocated television band of frequencies (in Band I) and created a number of areas where two or more transmitters can be received, possibly on adjacent channels within the band. It has become necessary to ensure that receivers will reject signals from the channels on either side of the one to which the receiver is tuned: thus, on the sound side the attenuation must be maintained, and on the vision side the response curve must fall away sufficiently sharply to give adjacent-channel rejection. The same methods as were noted for sound rejection apply in this case.

In commercial receivers both methods have been used. Traps tend to be simpler to fit and adjust but involve a loss of receiver performance, which may necessitate fitting an extra stage of amplification; the steep-sided selectivity curve can be obtained by using complicated coupling networks, which tend to be difficult to design and align. Amateur-built receivers have used traps almost exclusively since they are simple and the cost of an extra amplifying stage is of little importance to the amateur.

Current methods of obtaining the wide bandwidth necessary for the vision channel are the use of transformers, or frequency staggering, or a combination of both. The complications inherent in these methods were indicated in the previous article and they can be summarized here as: (a) transformers are not easy to design or manufacture but are relatively non-critical once correctly made; (b) frequency staggering uses simpler circuits but requires a complicated alignment procedure and is very dependent on capacitance and damping resistor values. The advantages to be expected from the use of feedback are: (1) the use of simple, single-tuned circuits; (2) a simple adjustment procedure; (3) insensitivity to small capacitance and resistance value changes.

The foregoing remarks consider the use of feedback to broaden an isochronous amplifier (i.e., tuned to a single frequency): feedback can also be used with transformers or staggering, and improves both at

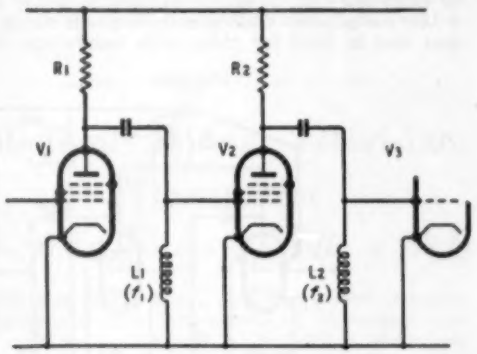


Fig. 1. Two stages of a conventional staggered i.f. amplifier. The first circuit is tuned to f_1 and the second to f_2.

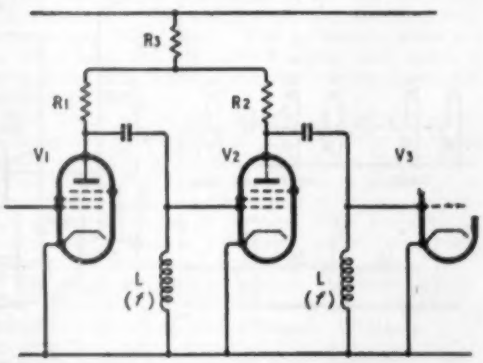


Fig. 2. Feedback amplifier with both circuits tuned to the same frequency (f).

* Decca Radar.
† "Wide-band I.F. Amplifiers" by H. S. Jewitt, *Wireless World*, February, 1954.

a sacrifice of simplicity. From one aspect, however, feedback presents a difficulty not met with in either of the other schemes—that of certain inevitable circuit capacitances. Consider Fig. 1, which is the circuit of two stages of a staggered amplifier. If R_1 and R_2 possess capacitance—as, being practical resistors, they do—it can be absorbed in the tuning capacitance and the coil made slightly smaller to maintain the tuning. Similarly, the effect of anode-grid capacitance may be allowed for. If, now, Fig. 2, the circuit of a feedback amplifier, be examined, a different state of affairs is seen to exist. Capacitances across the resistors R_1, R_2 and R_3 cannot now be absorbed in the tuning capacitance, and they will, in fact, affect the feedback both in magnitude and in phase. Again, the anode-grid capacitance of V2 has the effect of tilting the response curve, and, if it is sufficiently large, may produce a tilt which cannot be corrected. Both of these effects will become worse as the bandwidth decreases (and consequently the gain per stage increases): as R_1 and R_2 increase the effect of their self-capacitance will become more obvious, and the same holds for the effect of the anode-grid capacitance of V2.

It is apt here to consider one point of view on television receiver bandwidth—that of the radar receiver designer who considers television receivers as being of narrow bandwidth. This may be rather startling unless it is appreciated that the radar designer is usually concerned with "wide" bandwidths of 20 Mc/s or more and that, to him, a bandwidth of less than 5 Mc/s is narrow. Consequently, a circuit configuration that is ideal for radar wide bandwidths may present difficulties at television "wide" bandwidths. This is so in the case under discussion. The values of R_1 and R_2 (Fig. 2) needed for 3 Mc/s bandwidth are so high as to lead to difficulties with their stray capacitances. Similarly, the resultant gain per stage of approximately 26 db is higher than any normally used in radar practice with feedback amplifiers, and leads to tilt trouble with the anode-grid capacitance.

Circuit Configuration

With the foregoing difficulties in mind, an experimental design of a vision i.f. amplifier was attempted. One primary parameter to be chosen was the i.f. itself: this is preferably low to reduce the troubles associated with stray capacitance effects. An arbitrary choice of 16 Mc/s for the vision carrier and 19.5 Mc/s for the sound carrier was made. The circuit configuration was considered, and, bearing in mind the experimental nature of the work and the requirement for simplicity, it was decided to use two flat feedback pairs. This choice was also conditioned by the stray capacitance problem, for other feedback circuits generally use higher resistor values. A quick computation of the gain to be expected from two pairs yielded a result of approximately 100 db, assuming the Mullard EF91 valve to be used. If the first of the four valves be made the mixer and detection losses are taken into account, an overall gain figure from mixer grid to detector output of 75 to 80 db is to be expected, and this appears to be a reasonable value. The flat pairs were initially designed using the data

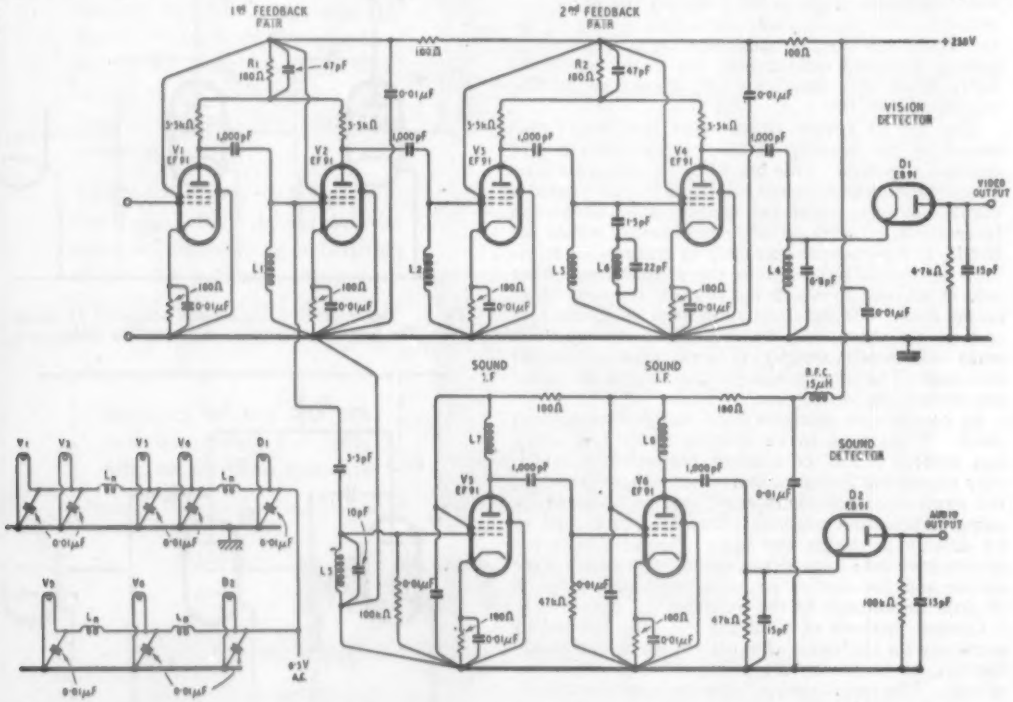


Fig. 3. Complete circuit diagram of i.f. section of a receiver, with diode detectors. Coils L_1 to L_8 are wound on Aladdin formers, dust-core tuned and screened. No other screening is used. L_1, L_2, L_3, and L_4 : 27 turns of 30 s.w.g. close-wound. L_5, L_6, L_7, and L_8 : 20 turns of 30 s.w.g. close wound. L_R : about 15μH (type of coil not important).

given in the previous article and the resulting i.f. amplifier was constructed.

As had been anticipated, stray capacitances modified the response curve considerably and some modification of resistor values had to be made. This is normally regarded as most unusual at wider bandwidths, but was not unexpected in this case. Due again to the capacitance problem, a very large value of tilt-compensating capacitance was necessary to overcome the falling-off on the high frequency side of resonance. Traps were fitted to the completed vision amplifier for sound rejection and these produced some modification of the response curve. It had been hoped that much of this change could be corrected, using the tilt compensator, but as this had already been raised to its limit value, it was not possible. The aligning frequency was therefore raised from 17.5 to 18 Mc/s. Finally, a sound amplifier was added, taking its input from the first sound trap.

Fig. 3 is the circuit diagram of the complete i.f. section for a receiver. V1 would be the mixer, possibly preceded by an r.f. stage (certainly for Band III use), and the only requirement on this valve is that its output capacitance should be very close to that of the EF91s used throughout the amplifier. V1 and V2 form the first pair, and V3 and V4 the second. Contrast control may be applied to the mixer and to V3, but V2 and V4 cannot be so controlled since variation of the gain of these stages affects the feedback factor and hence the bandwidth. The sound i.f. amplifier comprises V5 and V6 in a conventional narrow-band circuit. The two detectors D1 and D2 may be either thermionic diodes as shown or germanium crystal diodes (the Mullard OA73 for example).

The alignment procedure for this amplifier consists in short-circuiting R_1, and adjusting L_1 and L_2 to resonate at 18 Mc/s. This short-circuit is then removed, R_2 is short-circuited and L_3 and L_4 are made resonate at the same frequency. With the signal generator set at 19.5 Mc/s, L_5 and L_6 are adjusted for minimum signal at the vision detector and L_7 and L_8 for maximum signal at the sound detector.

The response curve obtained in this fashion is shown in Fig. 4. This is not ideal for television reception but indicates that a usable response curve can be obtained with such a simple amplifier. It should be noted that the response is not −6 db at 16 Mc/s, the vision carrier frequency, but approximately −4.5 db: this allows for the effect of the mixer and r.f.-stage tuned circuits. The dotted curve on Fig. 4 shows the result of changing all four valves in the vision amplifier, without any re-alignment, and indicates the lack of sensitivity of the circuit to valve changes. The replacement valves were chosen at random from batches other than those of the original four.

Performance Figures

The amplifier measurements made (apart from the vision response curve) give the following results:—

Vision gain, V1 grid to D1 output	:	92 db
Sound gain, V1 grid to D2 output	:	97 db
Sound channel bandwith to −3 db points	:	210 kc/s
Sound rejection on vision channel	:	−35 db
Vision rejection on sound channel	:	−57 db
Adjacent sound channel rejection on vision	:	−35 db

The principal effect of the valve change was to reduce the sound rejection to −28 db.

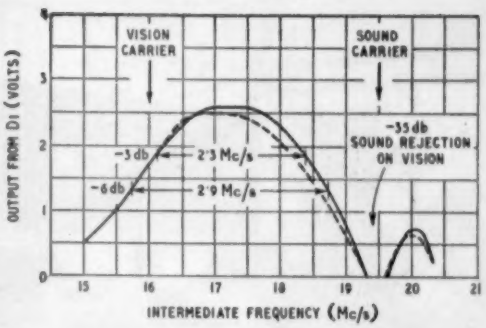


Fig. 4. Response curve obtained from the vision circuit in Fig. 3. The dotted curve shows the effect of changing the valves.

This experimental circuit indicates the possibilities for television of the negative feedback i.f. amplifier. It cannot be expected to show to best advantage at the rather narrow 3 Mc/s bandwidth of the present British television system, but, even at this bandwidth, may well be used where simplicity of construction (the absence of transformers) and of alignment (no frequency staggering) is important.

The author would like to thank Mr. S. H. Knight for much helpful advice and assistance in the experimental work.

Medium Power Television Transmitter

New B.B.C. Station in the Isle of Wight

THE first of the B.B.C.'s medium-power television transmitters came into service on November 12th. It operates on Channel 3, 56.75 Mc/s vision and 53.25 Mc/s sound, with vertical polarization and a power of 5 kW peak-white for vision and 2 kW carrier for sound.

The station is at Rowridge in the Isle of Wight 470 ft above sea level and is at present operating with a temporary 200-ft mast. The permanent mast will be 500 ft high and will carry a higher gain aerial; it is expected that it will come into service during the autumn of 1955.

The vision signal for modulating the transmitter is brought in by a radio link. A Post Office receiving station at Alton in Hampshire receives the London signal on Channel 1 and transmits it to Rowridge on a microwave link. The receiving aerial is a paraboloid on the 60-ft level of the mast. The sound signal comes in by line, a submarine cable being used between the island and the mainland.

The vision transmitter employs low-level modulation, actually at a 500-W level, the subsequent amplifier comprising two wideband linear r.f. stages in cascade. Each stage has two forced air-cooled triodes operating in class B. An unusual feature is the omission of a special vestigial-sideband filter, the appropriate shaping of the sidebands being obtained

View of the vision and sound transmitters at Rowbridge with the control desk in the foreground.

instead by the design and adjustment of the tuned circuits of the amplifier.

The transmitter is crystal controlled with a long-term stability better than 0.002%. Frequency multipliers and amplifiers bring the r.f. power to a level of 50 W to drive the push-pull tetrode modulated amplifier. This is grid modulated.

The video circuits, which amplify the received signal, to drive the modulator include sync-pulse stretching and picture-amplitude shaping circuits.

The transmitter has been manufactured by Marconi's Wireless Telegraph Co., Ltd., who have also made the sound transmitter. This is of the class B modulated type rated for 2 kW output. It will normally be used to deliver 1.25 kW in order to maintain the standard ratio of vision to sound power; that is, equality of peak power.

The station includes a stand-by 500-W vision and 125-W sound transmitter made by Standard Telephones & Cables, Ltd.

The power supply comes from the grid at 11 kV and is transformed to 415-V 3-phase on the site. A local supply from a diesel-driven generator is available for emergency use and permits low power operation.

No studio or camera facilities are provided but this does not prevent the origination of programmes in the island. The usual O.B. vans can be used and the station can accept the signals from them and transmit them to the main television network.

H.F. CABLES AND CONNECTORS

Preferred Impedances Agreed by I.E.C.

ONE of the sub-committees to the International Electrotechnical Commission, which met in Philadelphia during the recent jubilee congress, is concerned with h.f. cables and connectors. There were three British representatives on this sub-committee and we are indebted to one of them—R. W. Kersey of Mullard, Ltd.—for this brief report.

The main object of the meetings of the sub-committee was the reconsideration in the presence of American specialists of the work done at the first meeting held at Lugano last April. Twelve nations were represented on the committee at Philadelphia by over thirty delegates, nearly half of whom were Americans.

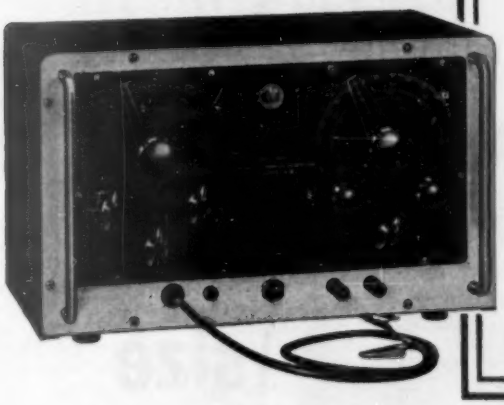
For two days discussions were mainly concerned with preferred impedances and diameters for h.f. cables. A British document was submitted in answer to the German plea for the selection of 60 ohms rather than the preferred values of 50 ohms and 75 ohms which are in accordance with British, American and French practice, both as regards Services and industry applications, and moreover had been accepted at Lugano.

Other matters that were dealt with included coaxial aerial connectors for television (based upon a British proposal) and a general requirements specification for h.f. cables.

It may be said that the interchange of ideas had proved valuable and that in general the experience of U.S. Services and industry supported the conclusions that had previously been arrived at in Europe. The American delegates were evidently impressed by the technical level of work already done by the sub-committee and there is, therefore, every reason to suppose that the keen American co-operation that was so evident at Philadelphia will be maintained at future I.E.C. meetings in Europe and, in particular, at the next meetings of the sub-committee to be held in London during the summer of 1955.

PUBLICATION DATE

We regret that owing to the Christmas holidays it will be necessary to postpone publication of the January issue of *Wireless World* from December 27th to January 3rd.



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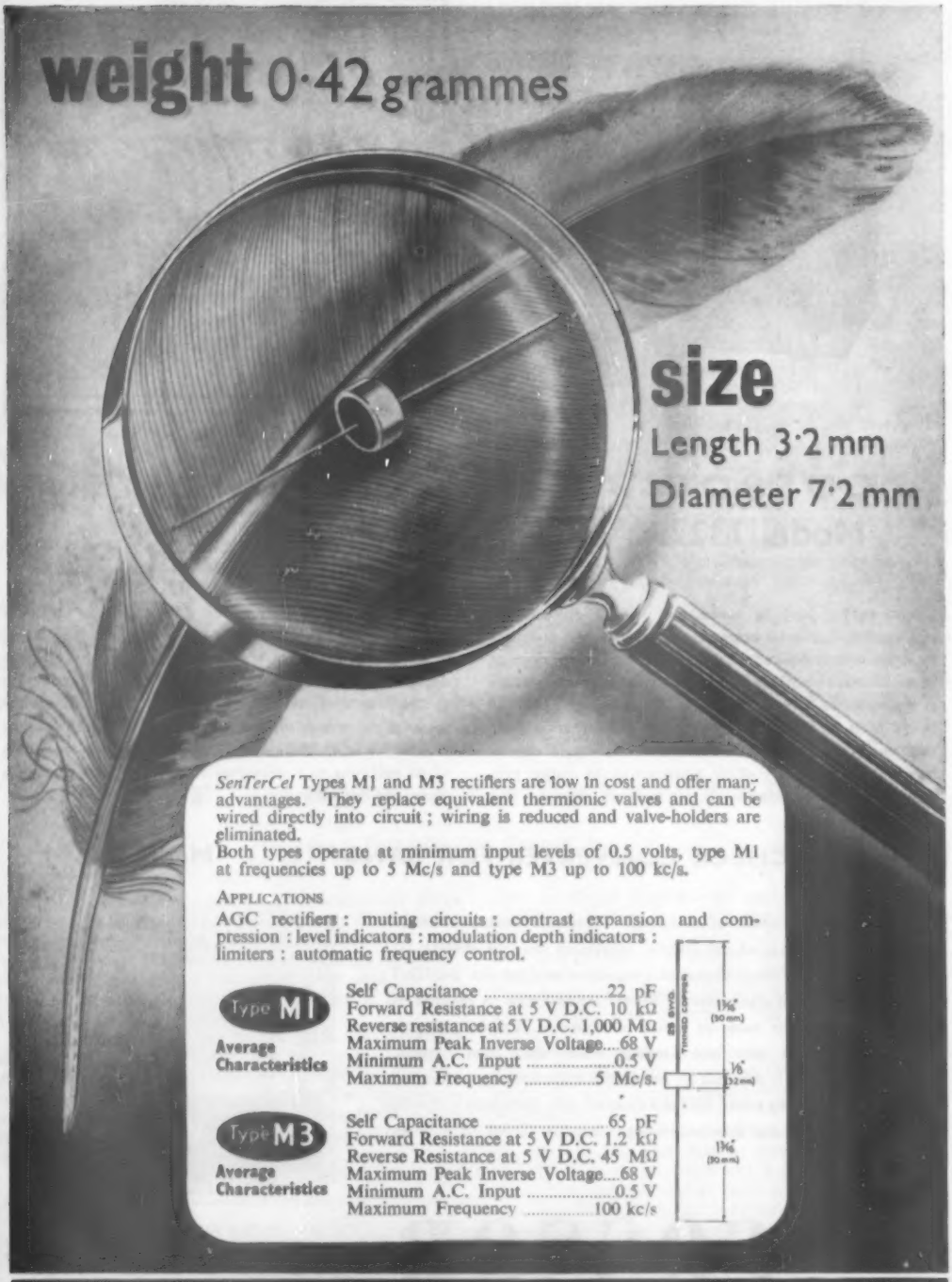

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APPLICATIONS

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Type M1 — Average Characteristics

Self Capacitance	22 pF
Forward Resistance at 5 V D.C.	10 kΩ
Reverse resistance at 5 V D.C.	1,000 MΩ
Maximum Peak Inverse Voltage	68 V
Minimum A.C. Input	0.5 V
Maximum Frequency	5 Mc/s.

Type M3 — Average Characteristics

Self Capacitance	65 pF
Forward Resistance at 5 V D.C.	1.2 kΩ
Reverse Resistance at 5 V D.C.	45 MΩ
Maximum Peak Inverse Voltage	68 V
Minimum A.C. Input	0.5 V
Maximum Frequency	100 kc/s

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Signal-Operated Switching

Fault-warning System Using a Thyratron Valve

By R. SELBY*

THERE are a number of occasions when it is necessary to arrange for a certain switching operation to be performed automatically by the starting or cessation of an audio signal. These may include voice-operated send-receive switching for radio communication and intercom systems, start and stop arrangements for tape recording, and fault-warning systems for radio relay services. The last mentioned case is the one which concerns the writer, and as in some ways it presents the most difficulties, a description of a simple practical scheme is given. A similar unit would probably be useful to radio servicemen when "soak-testing" receivers having obscure intermittent faults.

In all these applications time is an essential element. Generally it is required that operation of the switching relay should occur as quickly as possible after commencement of a signal, but that there should be a controllable delay after cessation of the signal before the relay changes over. For communication purposes this delay will require to be long enough only to avoid false switching during normal pauses in speech, but in the case of a programme-failure alarm it must extend to a period slightly longer than the expected maximum interval in the programme. This may vary between 20 or 30 seconds for the Light Programme and 3 or 4 minutes for the Third Programme.

A system incorporating a conventional negative feedback time delay circuit has been described elsewhere† and has been used with fair success for some two or three years. The basic circuit is shown in Fig. 1. The audio signal is rectified by the diode and charges C ($4\,\mu F$) negatively so that the triode is cut off. Upon cessation of the signal, C discharges slowly through R, R_k, and the relay winding. Approximate resistances are $5\,M\Omega$, $5\,k\Omega$ and $1{,}000\,\Omega$ respectively. The triode grid slowly rises to the same potential as the cathode, allowing anode current to pass and the relay to operate, but the action is prolonged by the feedback effect of the high resistance in the cathode circuit. This system suffers from several disadvantages. One is the fact that some valves are unsatisfactory with such a high value grid resistor. Another is the very slow rate of change of anode current, which does not allow the relay to operate smartly, resulting in "dithering" of the contacts and difficulty in setting and maintaining a definite delay period. The latter varies considerably with the adjustment and spring load of the relay. A further complication which arises when it is desired to feed several such units from a common power supply is the necessity for voltage stabilization.

Fig. 2 shows the basic circuit of a system which is considerably simpler, has fewer variable factors, and which gives positive operation of the relay. The triode is replaced by a thyratron, thus ensuring that the relay is either fully energized or completely non-energized, so that precise adjustment is unnecessary and a full spring load may be carried.

Since the thyratron current is either zero or a maximum determined by other circuit elements, a negative feedback circuit cannot be used, and the required delay can only be obtained by the simple discharge of a capacitor through a resistor. For-

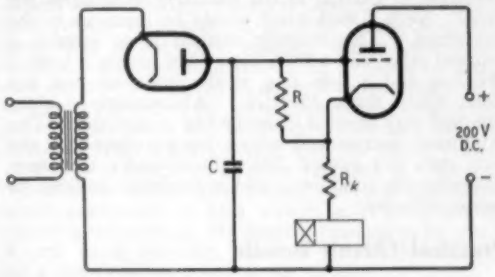


Fig. 1. Basic circuit of signal-operated switching system described in the text.

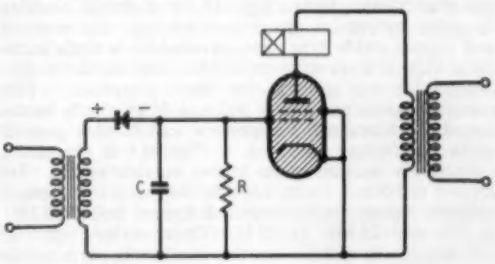
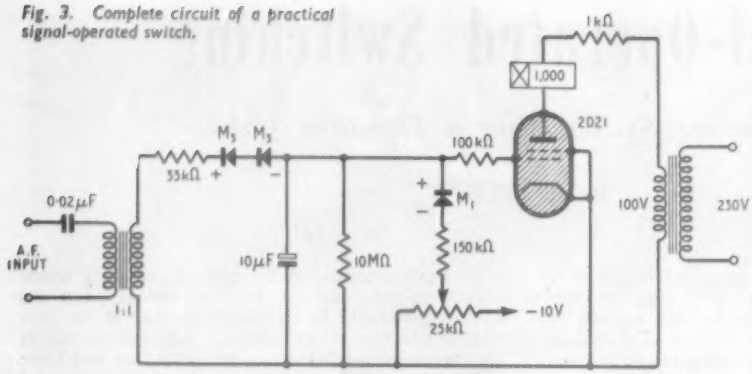


Fig. 2. Modified circuit using a thyratron valve.

Experimental single-channel unit using high-insulation resistance electrolytic capacitor as delay element.

* Metropolitan Relays, Ltd.
† *Relay Association Journal* March 1951

Fig. 3. Complete circuit of a practical signal-operated switch.



tunately the rule of thumb formula for such a time constant, $T = CR$, where T is in seconds, C in μF and R in MΩ, is not strictly correct, otherwise impossibly high values of C and R would be needed. It was found quite practicable to take advantage of the latter part of the exponential voltage decay curve for a CR combination, where the voltage is dropping at a progressively slower rate. This, combined with the small range of critical grid voltage required to strike the thyratron, enables delays of several minutes to be obtained, providing the initial voltage is reasonably high.

The anode of the thyratron is supplied with a.c., so that the grid has the opportunity of regaining control at every half-cycle. When the negative grid potential is below the critical value the thyratron is conductive and behaves as a half-wave rectifier with the relay as the load. Under these conditions it is necessary to prevent the relay buzzing and also to prevent a high back-e.m.f. being generated by the cessation of current in the inductive winding of the relay. Such a back-e.m.f. would be injurious to the thyratron. The simplest method is to employ a slugged relay, and a P.O. Type 3,000 having a 1,000 Ω winding and a $\frac{1}{2}$-in slug at the armature end has been found quite effective. Alternatively a plain winding may be used if shunted by a capacitor. The additional operate and release lag introduced by the slug does not exceed 200 millisec under the most unfavourable conditions, and is therefore unlikely to cause difficulty.

Practical Circuit Details

The opportunity was taken when designing this simplified unit to explore the possibility of replacing the thermionic diode (Fig. 1) by a metal rectifier in order to reduce space and wiring. Germanium and copper-oxide types are unsuitable, as their comparatively low reverse resistance allows C to discharge far too quickly for most purposes. The miniature selenium Types M1 and M3 recently introduced by Standard Telephones and Cables proved quite satisfactory however. The M3 is the more suitable on account of its higher current rating. Its reverse resistance varies considerably with the applied voltage, representative nominal figures being 45 MΩ at 5 V and 25 MΩ at 15 V. These values are not low enough in relation to the maximum permissible grid-cathode resistance of the thyratron (10 MΩ for Type 2D21) to affect the time constant greatly, and in any case it will frequently be necessary for other reasons to employ two or more rectifiers in series, when the total reverse resistance becomes high enough to be ignored. Moreover, it is over the useful working range of lower voltages that the resistance rises.

The practical circuit is shown in Fig. 3. The 0.02-μF capacitor in series with the a.f. input serves no essential purpose, but was fitted in a particular instance to reduce the response to hum frequencies. The ratio of the transformer depends on several factors, including the voltage and impedance of the a.f. source, the time delay desired, and the required speed of response on resumption of the input signal. The resistor of 100 kΩ at the grid is a probably unnecessary precaution to protect the thyratron from excessive grid current in the event of failure of any other component, or accidental reverse connection of the rectifier. The resistor (1 kΩ) in the anode circuit limits the current to a figure well below the maximum rating of the 2D21. It might need to be reduced slightly if an unusually heavy spring load is required on the relay. In order to operate the thyratron at a low critical grid voltage point the anode supply is of the order of 100 V only. It should be noted that it is not possible to employ a higher voltage transformer winding in conjunction with a series voltage-dropping resistor, since, until the thyratron fires, there is no current and therefore no voltage drop.

The primary elements in determining the time delay are, of course, the grid capacitor and leak resistor, and the values shown are the maximum likely to be required for most purposes. Where delays of up to one minute only are required, C could often be reduced to about 4 μF. It must naturally have a high and stable insulation resistance.

The delay period is also a function of the voltage existing across the capacitor at the moment when the input signal ceases. In other words the delay is affected by the level of the final signal. Where a fairly constant signal level is maintained, as might be the case for communication purposes, this point may not cause difficulty, but where, as in the writer's case, the system is to operate from broadcast programmes, some means of compensating for wide variations in signal level is necessary. A d.c.-limiter with adjustable bias is therefore incorporated, and this uses also a miniature selenium rectifier. It is very unlikely that the bias will require to be adjusted to a figure approaching the maximum d.c. reverse voltage rating (20 V), and a single M1 rectifier should suffice. The maximum current rating of this type is, however, only 250 μA, and it is therefore necessary to restrict the current on peak signals by inserting a 150-kΩ series resistor. This has the effect of slowing up the limiting action somewhat, so that there is a few seconds variation in the delay between maximum and small signal voltages. If closer timing is essential, the series resistor may be much reduced and the single M1 rectifier replaced by two or three Type M3 in series. This is necessary to maintain sufficiently high reverse resistance.

A bias supply of about −10 V will usually be sufficient and may be obtained by any convenient means, such as by a shunt diode rectifier circuit fed through a capacitor from the 100-V winding on the transformer. If an additional low-voltage winding is available for pilot bulbs, alarm bell, etc, this may be connected in series-aiding with the 6.3-V heater winding to supply a small metal rectifier. A single 25-μF capacitor provides sufficient smoothing.

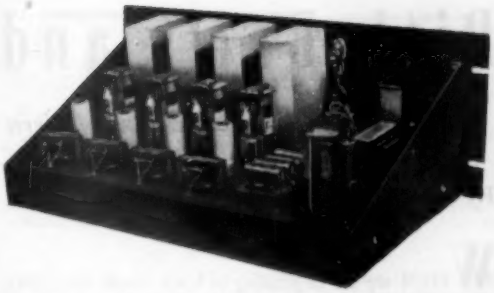
The potentiometer (25 kΩ) for adjusting the bias, automatically provides a very effective means of adjusting the time delay because its setting determines the starting point of the effective CR discharge curve, assuming that a signal greater than the bias voltage has been received recently. If a prolonged low signal is being fed in, and then ceases, the charge on C may initially be lower than the bias voltage, and the delay will be shortened. A numerical example may make this clearer. Assume a delay of three minutes is required and that this can be obtained when the potential across C is 9 V. The limiter bias will therefore be adjusted to 9 V, and a final signal of 9 V or more will offer the correct delay period. But if for the past three minutes or longer a signal at only 5 V has been received, and is then interrupted, C commences its discharge with an initial voltage of only 5 V, and a period of less than three minutes elapses before the thyratron fires. Fortunately, in practice it would be uncommon to find a programme containing such a relatively low signal lasting for such a period without a single peak, and then followed by a further period of complete absence of signal. It will usually be satisfactory to set up the adjustments at a signal level corresponding to quiet speech. Greatest constancy of time delay is obviously achieved if the unit is fed with an adequately high signal, so that even on quiet passages, C is charged to the maximum potential permitted by the setting of the limiter bias.

It will be clear also that with given values of C and R, the lower settings of bias voltage give correspondingly shorter time delays, but greater constancy. The following table shows the time in seconds taken for the relay to operate after the input signal is reduced to zero from the value given in the first column. Figures are given for three settings of bias voltage, the test frequency being 1,000 c/s and the component values those given in Fig. 3.

Signal Volts (r.m.s.)	Bias Voltage			Release time
	−5	−7.5	−10	
4	87	73	62	3
5	115	105	110	2
10	125	170	197	1
20	130	172	203	—
50	133	174	210	—

With the limiter circuit disconnected, a delay of 310 sec is obtained following a signal of 25 V r.m.s.

The column headed "release time" refers to the period taken for the relay to open after re-application of the signal. This time may be decreased by reducing the value of the series resistance in the rectifier circuit. It is not essential for the signal to fall completely to zero for operation, and the relay will close if the input falls to approximately 2 V. The minimum signal required to release the relay is 3.75 V. There is thus some degree of backlash between the two conditions.



Four-channel unit transmitting d.c. warning signals over P.O. lines in event of programme failure at a substation.

The 33-kΩ resistor in series with the signal rectifiers is for the purpose of limiting the current to a figure within the maker's rating of 1 mA average. No figures are quoted for maximum peak current. This series resistance increases the charging time of C to some extent and therefore slows up the release time of the relay. It should therefore in most cases be kept to the minimum safe value, which will depend principally on the maximum a.f. voltage to be applied. All the component values given in Fig. 3 refer to a unit designed to operate from an a.f. source having a maximum level of 100 V r.m.s.

Precautions

Care must be taken not to exceed the peak inverse voltage rating of 68 V for the rectifiers, and it may often be necessary to use two or three in series. Where no d.c. voltage limiter is used, the load resistance is very high, and the p.i.v. is almost twice the peak value of the signal voltage. When a limiter is used, the effective load resistance is much reduced and must be considered in relation to the total series resistance (including the source resistance) in arriving at the p.i.v., which will be lower in this case. When operating from a 100-V signal with the circuit values of Fig. 3, a minimum of three rectifiers is required. Whether the comparatively short duration and infrequent occurrence of peak signals in practice would permit a reduction in the number remains to be seen. A unit using two only has run without breakdown for a few hundred hours so far.

One small point to bear in mind is the maker's recommendation to allow 20 sec cathode heating time for the 2D21 before allowing anode current to flow. In some circumstances this might call for delayed switching of the anode supply.

This circuit (Fig. 3) enables a very simple and compact unit to be built, which gives positive operation of the switching relay. Where timing requirements are particularly stringent, the limited current ratings of the miniature selenium rectifiers might make it desirable to revert to the use of thermionic diodes.

If the relay is required to remain operated after the signal has been re-established, this can easily be arranged by providing an extra contact which breaks the input circuit when the relay closes. Manual resetting may then be performed by breaking the anode circuit momentarily.

Pith Balls and Grid Current

Traditional Electrostatics In Modern Valve Design

By "CATHODE RAY"

WHEN we are beginning to learn about electricity, all concerned are naturally in a hurry to get on to something interesting and practical. So the least time is devoted to the nature of electric currents as will just about give us the impression that we know about them. The rest of our lives are spent in discovering that we didn't really know. If our elementary course had tried to tell us, we would have stuck there the whole time. Which would have been discouraging. Most of us need all the encouragement we can get, and it consists mainly of looking back down the hill and seeing how far we have climbed. Perhaps fortunately we do not yet see the altitudes hidden behind the peak close above. To scale these it is often necessary to descend once more to levels we thought we had left for good.

Take this matter of electric current, for instance. In order to work out all those examples of series and parallel circuits, we needed only to know that an electric current was something like water flowing through a pipe, or (if we were very up to date) like a mob of people surging through a street full of stationary obstructions. This concept did us quite well until we came to capacitors; and even then the resourceful instructor or author got us by with the aid of a slight extension of the original idea. On reaching the chapter on valves, however, the water-pipe idea begins to get into serious difficulties, and the advantages of the electronic approach become manifest. At this stage I fancy most of us were informed that the vacuum inside a valve is a clear space across which the electrons leap, provided that the jumping-off place (the cathode) is heated in order to release them into the space, and a sufficient inducement is provided, in the shape of a positive potential, at the place of arrival (the anode). Since the strength of an electric current is proportional to the number of electrons passing a given point per second, the current in the wire joining the anode to the source of positive potential is proportional to (we may perhaps even say, consists of) the electrons arriving at the anode from across the vacuum.

This picture gets us quite a long way. But when we come to valves for frequencies higher than about 30Mc/s, we are again in difficulties. We find that there are currents in the anode or grid circuits even when electrons don't arrive at all. And so we have to go back to the beginning again and revise our ideas about electric currents. Why weren't we given these ideas at the start and so save a lot of trouble? Well, just as I said—if we had been given them at the start we would probably have decided to become chartered accountants or fishmongers. And in any case, even our re-revised ideas will no doubt have to be re-re-revised some day.

In the meantime, we won't get very far towards understanding valves at v.h.f., u.h.f., s.h.f., e.h.f., and the rest of the series to infinity, on the basis of counting arrivals at the anode or any other electrode; that is to say, on a mere extension of the idea of the number of electrons passing any point in the circuit per second. The really old boys, who went to school in the days of pith balls and catskins, may be able to teach us a thing or two, because they did at least learn something about induced charges. But in those days the idea of charges going about entirely by themselves was too highly theoretical and imaginary, perhaps, to take root firmly, and the teaching on the subject soon congealed into Leyden jars and, much later, silvered ceramic capacitors. But the principle is really the same.

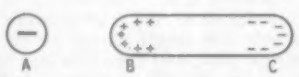


Fig. 1. Typical illustration from old-style book on electricity, showing the effect of a negatively charged body A on a previously uncharged conductor BC when brought near.

Fig. 1 is typical of what we see in the older books. A represents a negatively charged body (they were always bodies or conductors) brought near a sausage-shaped uncharged conductor BC. It was then demonstrated by means of gold-leaf electroscopes, etc., that B became charged positively and C negatively. Before A had come on the scene, these opposite charges were uniformly distributed throughout BC, so neutralized one another. Now the positive (unlike) charges have been attracted by A, and the negative (like) charges repelled. The next step was usually to earth C, allowing the negative charges to get still farther from A by leaving BC altogether. C was then disconnected from earth, leaving BC with a positive excess. When A was taken away, BC as a whole retained a positive charge, because the neutralizing negative charges that had gone to earth had no means of returning.

If this kind of experiment is still demonstrated, I suppose it is much the same except that the negative charges are called electrons and the positive charges are explained as the molecules deserted by the electrons and therefore electron-deficient or positive.

At a later stage in our education the situation would be described in terms of field and potential. A, being negatively charged, is surrounded by an electric field, and if BC were not a conductor, the locality B (being nearer to A) would be at a more negative or lower potential than C (Fig. 2 (a)). But as it *is* a conductor this potential difference immediately causes a current to flow to the end having lower potential; i.e., from C to B, which is really a negative current (of electrons) from B to C. When sufficient charge has been moved to neutralize the p.d., the current obviously ceases. Under static conditions, and with no e.m.f., a conduc-

tor must all be at the same potential. It therefore distorts the field around a charged body such as A by setting up a counter-field of its own. As shown in Fig. 2 (b) the positive charges at the B end raise the potential there from its previous -15 V to -10 V, while the negative charges at the C end lower it from $-7\frac{1}{2}$ V to -10 V.

If a sensitive galvanometer were inserted between the two halves of the conductor BC, it would show a current in one direction so long as A was moving towards it, and in the opposite direction when it was moving away. The same thing would apply if the galvanometer were connected between BC as a whole and earth—or any other conductor, at any potential. In every case the current would be necessary to shift some charges in order to neutralize the difference of potential that would otherwise be set up by the electric field from A.

It is the same if A is not a "body" at all but just one or more electrons, and BC an electrode in a valve. Fig. 3 shows an enlarged section of a valve with cathode K, grid G, and anode A. As usual, the grid consists of a spiral of wire coaxial with the cathode; the turns are all shorted together by connecting wires. The external circuit part of the diagram shows that relative to the cathode the anode is fairly highly positive, while the grid is slightly negative. The electrons that have boiled off from the surface of the cathode are therefore repelled by the grid but attracted by the anode, and they stream between the grid wires somewhat as shown. The reason they thin out as they approach the anode doesn't mean that some of them are disappearing on the way; it is because they are accelerating. If you were to empty a sack of lead shot from the top of a high tower, the shot would be a compact mass as it left the sack, but by the time it reached the ground would have thinned out considerably—fortunately for anyone who might happen to be passing.

Even with ordinary receiver voltages the electrons are quite mobile by the time they hit the anode; with 200 V, about 18,000,000 m.p.h. (Of course in a vacuum there is no sound barrier, so they can hardly be described as supersonic.) When these widely spaced electrons reach the anode they find that it, being a conductor, is already densely crowded with electrons. So an extremely slow movement of this

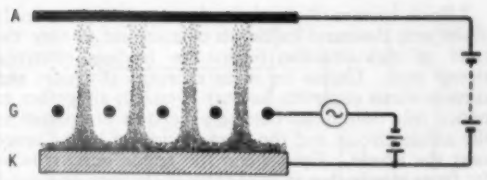


Fig. 3. Enlarged section of a valve, showing electrons streaming between the grid wires to the anode.

crowd along the external circuit towards the cathode is sufficient to make room for the new arrivals and so preserve the electrical balance of the circuit. As I mentioned in "How Fast is Electricity?" (Jan. 1954 issue), the contrast in speed is quite astonishing. The 18,000,000 miles per hour becomes something more like one *inch* per hour. Yet because of their relatively enormous numbers in metal as compared with the vacuum, there are just as many passing a given point in the wire per second as in the vacuum where they are going so fantastically fast. That is because under steady-current conditions the current is the same number of milliamps everywhere around the circuit.

Traffic Census

The foregoing is the usual picture one gets when first studying valves. But note the proviso—"steady-current conditions." If we enquire into what happens when the anode voltage is first switched on, and remember our old-fashioned electrostatic experiments, we will realize that here is a negative charge (but without its "body") being brought near a conductor (the anode) and that therefore movements of electrons must take place on the anode directly the electrons start moving towards it from the cathode. In other words, there is a brief moment, before the leading cathode electrons have reached the anode, when a traffic census officer stationed in space close to the anode would see no electrons at all passing him and would therefore report zero electric current; yet at the same moment electrons have begun to move away from the surface of the anode towards + h.t., under the advance influence of the approaching electron field, and these constitute an anode current.

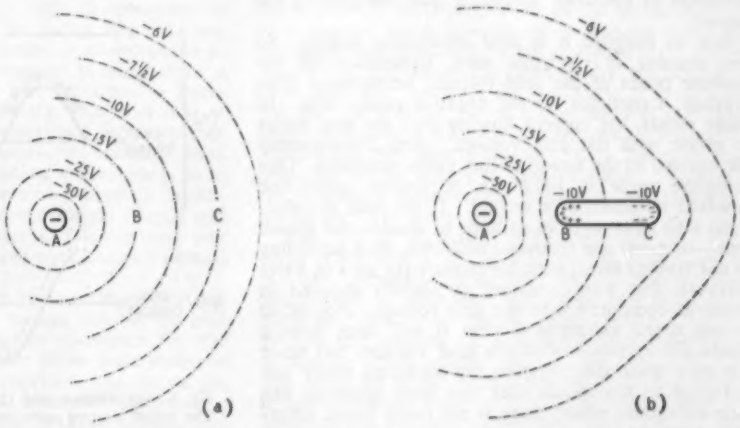


Fig. 2. If there were no conductor near A, equipotential lines would form a concentric pattern around it as at (a). Under static conditions a conductor must all be at the same potential, so when BC is present it must set up in itself a charge pattern that will distort the resultant field as shown at (b).

"Brief moment" is right, for he will have only about one thousand millionth of a second to note the facts of this situation before the leading electrons sweep past. Unless he is an exceptionally alert and conscientious observer, he may even fail altogether to notice this time delay between the start of current in the anode circuit and the start of current in the space near the anode. Even when the anode current is so far from steady that it is varying at the rate of a good many megacycles per second, this discrepancy is too small to matter in practice. But it is there, and at really high frequencies it does matter. In fact, in microwave valves such as magnetrons, it is everything. So for these valves our elementary ideas about electric currents may be a handicap. According to those ideas, it seems quite wrong and incomprehensible for current to be flowing in one part of a series circuit and not in another—even for 10^{-9} sec. But I hope the old electrostatic experiments are still performed, because they show quite clearly that this microwave phenomenon is in accordance with the classical electricity of the nineteenth century. Some teachers are now saying that when considering valves we should regard the circuit currents as primarily due, not to so many electrons arriving at an electrode, but to electrons moving towards or away from it. As Stevenson said, "To travel hopefully is a better thing than to arrive." When those electrons arrive, their speed is slowed down so much that they might be excused for supposing that they had come to a standstill.

Signal Conditions

At the now much discussed frequencies of Band I, Band II, or even Band III (of the order of 50, 100 and 200 Mc/s respectively) it doesn't make very much practical difference which way one regards the anode current. Looking again at Fig. 3 we see in the grid circuit, in addition to the bias source, the symbol for an alternating generator, which in practice would usually be a tuned circuit across which r.f. signal voltages are induced by coupling to an aerial or to another valve. Provided that this voltage is only a small fraction of a volt (as it normally would be) and the bias is adequate, the voltage of the grid never becomes so un-negative as to allow electrons actually to land on it. The generator varies its negativeness and thereby acts as a throttle, controlling the numbers of electrons squeezing past the grid to the anode.

Let us suppose it is now alternating gently. So the streams of electrons vary, sometimes (at the positive peaks of the grid voltage) being more than average; sometimes (at the negative peaks) less. In other words, the current flowing past the grid varies in phase with the grid voltage. And consequently the current in the anode circuit varies similarly. One complete cycle at 100 Mc/s, of course, takes one hundred millionth of a second. If the time the electrons take to cross from cathode to anode—the transit time—is about one thousand millionth, then according to our traffic officer, with his elementary idea of valve currents, the anode current is slightly delayed in phase as compared with the grid voltage. According to our more enlightened view it will start flowing practically in phase with the grid voltage; but since it is only when the electrons are travelling really fast and close to the anode that they have anything like their maximum effect, there is not really much difference between the two views. And what does it matter, anyway? A little transit-time phase shift in the anode circuit can easily get lost among other phase shifts, notably as a result of tuning or mistuning that circuit.

Induced Grid Currents

But it is now time to regard the grid as our "conductor BC," with negative charges being brought towards and away from it, faster by far than we could ever manage with our traditional laboratory "body." They, the charges, in the form of bunches of electrons, are sweeping past. Suppose for the moment that the generator is not generating, so there is no signal voltage, and the grid is at the steady bias voltage. The stream of electrons is consequently flowing steadily. So far as the grid is concerned they might just as well be standing still, for although the individual electrons are very much on the move there are always almost exactly the same number occupying any given part of the space in the valve. And every electron contributes exactly the same electric field, no matter whether its name is George or Harry. The "induced charge" effect of some of them moving away is counterbalanced by others moving towards. So there is no tendency for electrons to move either on or off the grid; i.e., no grid current.

Now switch on the signal. This makes the grid voltage vary as shown in Fig. 4 (a), alternately less and more negative than before. If the signal voltage were made to "hold it" at its positive peak, the flow of electrons past the grid would be greater than before, but it would be constant, so again no induced grid current. At a held negative peak there would be fewer electrons flowing past, but again no flow actually in the grid. But now consider the period between positive and negative peaks. The stream of electrons past the grid is thereby being checked. So there are fewer moving towards it than are moving away. In effect, a negative charge is being moved farther from a conductor. Some of the electrons that had previously been repelled from the grid by the larger negative space charge near it begin to return. In other words, there is a negative grid current. If a grid current were caused by the grid being joined to the cathode through a resistor, it would flow most strongly when the signal voltage was at its negative

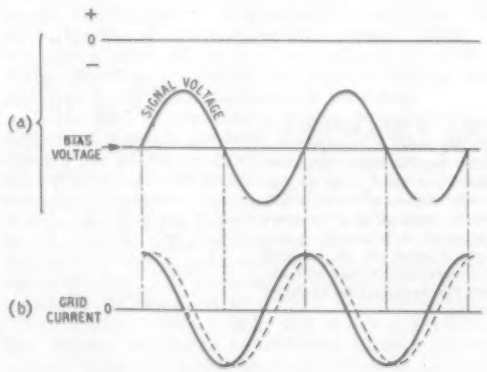


Fig. 4. (a) Voltage and (b) current diagram for the grid. The dotted current curve shows the effect of the time taken by electrons to move across the valve space.

peak. It would then be in phase with the signal voltage. But this negative grid current is flowing most strongly when the negative charge near the grid is becoming less negative most rapidly, that is to say, when the signal voltage is going negative most rapidly, which is when it is quarter of a cycle (90°) earlier than its peak negative, as shown by the full line in Fig. 4 (b).

Now a 90° leading current is what would flow in the grid circuit if the grid were joined to cathode through a capacitor. As a matter of fact such a capacitor is already there, because the grid and cathode, with the space between, form a capacitor of one or two pF, and a leading current would flow in the grid circuit because of that, even if there were no electrons flowing past at all—perhaps because someone had forgotten to switch on the heater. But we are ignoring that current at present. What we have found is that when at length the heater is turned on, so that electrons stream from it, there is more capacitive current between grid and cathode than there was before, and therefore, in effect, more capacitance.

This is serious, because at very high frequencies the grid capacitance forms a large part of the total tuning capacitance of the input circuit, and if in addition to what is there when the heater is off ("cold capacitance") there is some extra that varies according to electron space current—which is nearly the same thing as the anode current—then when this is varied by bias voltage, as in manual or automatic gain control, the capacitance varies and the tuning is altered. Now let's get this quite straight; this extra capacitance is not proportional to the space current. If you have followed the explanation you will see that it is proportional to the amount of *change* in space current brought about by a given change in grid voltage. In other words, it is proportional to the mutual conductance of the valve. But mutual conductance is precisely what one seeks to alter by gain control. So if the "extra" capacitance is an appreciable proportion of the total tuning capacitance, here is a possible snag. In practice it often is appreciable, and designers are aware of this snag and have to do something about it.

Power Loss

Although I mentioned very high frequencies as being particularly liable to be badly affected, and although the "extra" grid current is proportional to the rate at which the grid voltage plunges from a positive peak to a negative, or vice versa, and is therefore proportional to the frequency, this does not, of course, mean that the extra capacitance increases with frequency. The current through an ordinary fixed capacitance increases in proportion to frequency, so in this respect this peculiar electron-generated capacitance is like the real capacitance made up of grid and cathode acting as capacitor plates. The startling way it differs is in being proportional to the valve's mutual conductance.

Ever since we turned from the anode to consider what effect the varying grid voltage has on the grid itself, we have been making no allowance for the time delay that the traffic officer (if he were really on top of his job) would have reported. So far as the grid is concerned, this time taken by electrons to move from one place to another between cathode and anode means that when the grid voltage has ceased

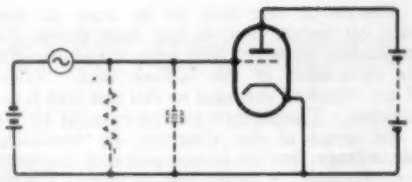


Fig. 5. The movements of electrons past the grid induce currents in the grid circuit equivalent to an extra capacitance and an extra conductance (dotted).

to become less negative and is pausing on its positive peak, the electron stream is still adjusting itself to this condition and there are still rather more electrons approaching the grid from the cathode than are departing for the anode. Consequently the extra grid current is not quite zero at the positive voltage peak; it is still slightly positive. Similarly at other stages of the cycle, as shown dotted in Fig. 4 (b). The general effect is to retard the phase of the grid current—to bring it more into phase with the voltage. It is the same as if part of the grid current flowing through the imaginary capacitor at the input of the valve were diverted through a resistor (Fig. 5).

This may be more serious than the extra capacitance. Provided that that is kept constant by keeping the mutual conductance constant, it can be allowed for by a slight reduction in tuning capacitance or inductance. But resistance means loss of power, which it may not be practicable to make good.

However, let us see how this resistance depends on frequency. First, let us suppose that the phase delay is a fixed proportion of the signal cycle. That means that of the total grid current caused by variation of space charge, a fixed proportion goes through the imaginary resistor and the rest through the imaginary capacitor. Keeping the signal voltage constant, let us increase its frequency. This increases the grid current in proportion. It is natural for this to happen when the impedance is a fixed capacitance. But so far as the in-phase part of the current is concerned, the effect can only be imitated by making the imaginary resistance decrease in proportion to the rise in frequency. So obviously the power loss gets worse at higher frequencies. But that is not all. The time delay is *not* a fixed proportion of the signal cycle; it is a certain fixed fraction of a second—say, one thousand millionth—regardless of frequency. So the higher the frequency the greater the fraction of a cycle this time becomes. At 100 Mc/s it is 10%; at 200 Mc/s it is 20%. So on this count, too, the imaginary resistance is inversely proportional to frequency. Taking the two effects together, it is inversely proportional to the square of the frequency. Doubling the frequency quarters the imaginary resistance and quadruples the power loss.

This line of argument holds good only for fairly small phase delays. To go to extremes, a phase delay of 360° would—disregarding other effects—bring things back to what they were at negligibly low frequencies. But even small phase delays are bad enough and account for a good deal of the difficulty in making valves amplify above about 30 Mc/s. At 300 Mc/s we would expect this part of the difficulty to be a hundred times as great. Certainly measurements of the imaginary valve input resistance confirm that it varies inversely as the square of the frequency,

but whereas at one time all or most of this was blamed on transit time it was later found that the blame had to be shared with something quite different —the inductance of the cathode lead. Valves for v.h.f. are therefore arranged so that this lead is as short as possible. Transit time can be reduced by increasing the speed of the electrons, by increasing the anode voltage; but it is not practical to carry that policy very far. A better line of attack is to reduce the distance the electrons have to go. At the same time this increases the mutual conductance, which increases the undesired grid current, but also increases the amplification. The whole thing becomes quite complicated, and anyway I am not a valve designer and this is not a treatise on valve design, so let us leave them to it. The point that is meant to emerge is that by pondering on the simple experiments performed by Faraday with glass rods and suchlike, one can explain the apparently obscure snags that affect the design of the valves and sets we shall need for our Band II f.m. and Band III TV.

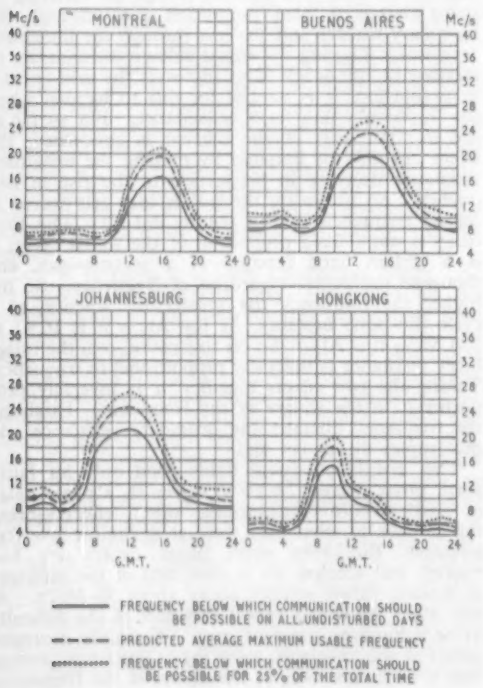
I have applied this early Victorian line of thought to only one phenomenon in modern valves, but clearly it is something to remember all the way through.

Short-wave Conditions

Predictions for December

THE full-line curves given here indicate the highest frequencies likely to be usable at any time of the day or night for reliable communications over four long-distance paths from this country during December.

Broken-line curves give the highest frequencies that will sustain a partial service throughout the same period.



Fifty Years of Wireless Telephony

THIS is the title of an article by Professor F. Benz in the *Archiv der Elektrischen Ubertragung*, 1954, p. 369, describing the celebration at Graz in Austria of the jubilee of a demonstration of radio-telephony given on June 15th, 1904, by Otto Nussbaumer in the Institute of Physics of the Graz Technical College. For this celebration the original apparatus was borrowed from the Vienna Museum and the experiments were repeated. The transmitter was in one room and the receiver in another room, some distance away.

As a detector Nussbaumer used a coherer in which the filings were replaced by granulated iron oxide; this was inserted in an aerial and a battery and telephone receiver connected across it. He used several different transmitting arrangements; in some he used a Duddell arc to generate an alternating current, which was then stepped up by an induction coil with a 2-cm spark-gap. The distant receiver reproduced the audio-frequency noise made by the arc. For the transmission of music and speech, in some cases he used a similar arrangement but with a microphone coupled to the oscillatory circuit of the arc, while in other cases he dispensed with the arc and inserted the microphone, suitably shunted, in series with a battery and the primary of the induction coil. In this way music and speech were transmitted, but naturally not of high quality.

A few people who had been at the original demonstration were also present at the jubilee demonstration. Unfortunately, Nussbaumer left only rather brief records of his work,* which he does not appear to have followed up. He died in 1930 at the age of 53, but in the previous year the 25th anniversary of his historical experiments had been marked by the presentation to him of the golden Badge of Honour by the President of Austria.

* O. Nussbaumer, "Kurzer Bericht über Versuche zur Übertragung von Tönen mittels elektrischer Wellen." *Phys. Zeitschrift*, 1904, p. 796; also *E.T.Z.*, 1904, p. 1096. See also "Wireless Telephony," by Ernst Ruhmer, trans. by Erskine-Murray, p. 98.

Commercial Literature

Television Aerials for Band 1. Ten different arrays constructed on unit principle to permit variation of fixing and interchangeability of parts. Catalogue (giving also details of dealer service facilities) from Belcher (Radio Services), 59 Windsor Road, Slough, Bucks.

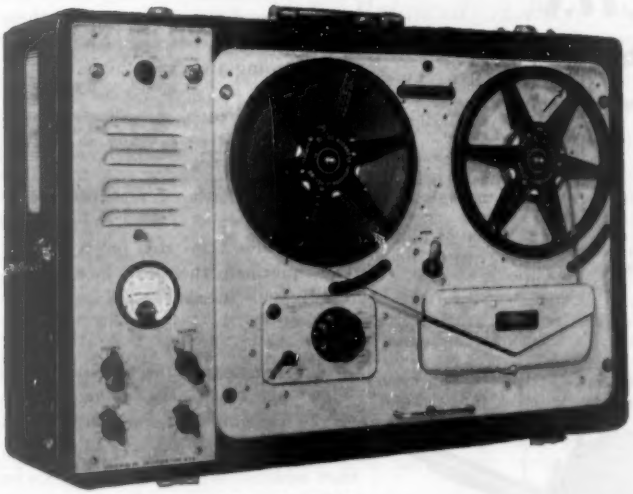
Precision Vernier Potentiometer with overall range of 1μV to 1.9V in two ranges. Accuracy is of the order of 1 part in 100,000 of the 1 volt setting. Also a **Portable Thermocouple Potentiometer** for temperature measurement, with two ranges, 0-21mV and 0-105mV. Leaflets from the Croydon Precision Instrument Company, 116 Windmill Road, Croydon, Surrey.

Printed I.F. Transformer is one of the American products described in the latest "Auri-News," a bulletin issued by Ad. Auriema, Inc., who are export agents for a large number of American firms. From 89 Broad Street, New York 4, N.Y., U.S.A.

Transfers for Control Panels. Set No. 1, for receivers and amplifiers, contains one tuning scale, twelve graduated scales for control knobs and associated wording with symbols. Set No. 2 is similar for test instruments. Price 3s 6d per set. From Data Publications, 57 Maida Vale, London, W.9.

Sound Reproducer, consisting of 15-watt amplifier and 12-in speaker in cabinet, with frequency response of 35 c/s-16 kc/s. Bass and treble tone controls are included and power supplies are provided for a tuner. Leaflet from Shirley Laboratories, 125 Tarring Road, Worthing, Sussex.

VORTEXION TAPE RECORDER



The amplifier, speaker and case, with detachable lid, measures 8¼in. x 22¼in. x 15⅜in. and weighs 30 lb.

PRICE, complete with WEARITE TAPE DECK £84 0 0

★ The noise level is extremely low and audibly the hum level and Johnson noise of the amplifier and deck are approximately equal. Only 25% of this small amount of hum is given by the amplifier alone.

★ Extremely low distortion and background noise, with a frequency response of 50 c/s.—10 Kc/s., plus or minus 1.5 db. A meter is fitted for the measurement of signal level and bias level.

★ Sufficient power is available for recording on disc, either direct or from the tape, without additional amplifiers.

★ A heavy mu-metal shielded microphone transformer is built in for 15-30 ohms balanced and screened line, and requires only 7 micro-volts approximately to fully load.

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★ A power plug is provided for a radio feeder unit, etc. Variable bass and treble controls are fitted for control of the play back signal.

★ The power output is 3.5 watts heavily damped by negative feedback and an oval internal speaker is built in for monitoring purposes.

★ Facilities are provided for using the amplifier alone and using power output or headphones while recording or to drive additional amplifiers.

★ The unit may be left running on record or play back even with 1,750 ft. reels with the lid closed.

POWER SUPPLY UNIT to work from 12 volt Battery with an output of 230 v., 120 watts, 50 cycles within 1%. Suppressed for use with Tape Recorder. **PRICE £18 0 0.**

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One milliwatt output on 600 ohm line (.775V) for an input of 30 micro-volts on 7.5-30 ohm balanced input.
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Calibration in 2 db steps, to plus 12 db and minus 20 db referred to zero level. Special low field internal power pack supplies 8 valves including stabilising and selenium rectifier, comsumption 23 watts.

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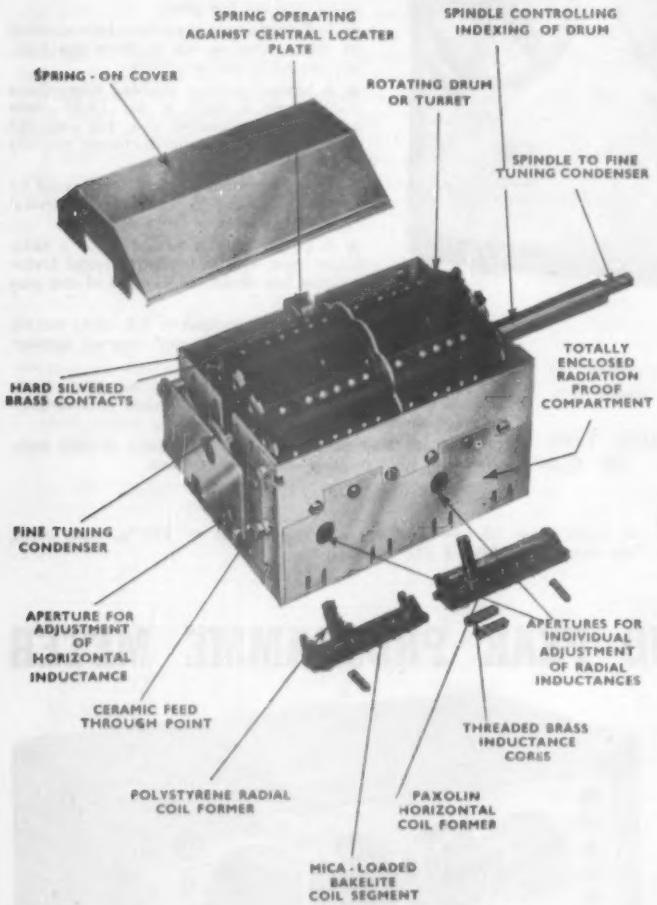
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The rotating drum of the Ediswan Clix Television Turret Tuner indexes accurately to any of twelve positions and re-sets precisely in these positions after switching. No question of mistuning after switching.

2 *All circuits are adjustable with the unit in position in a Television receiver.*

Adjustable cores to all inductances are easily accessible with the tuner in position in a Television receiver.
The tuner can, therefore, be set up or re-adjusted in its actual operating position.

3 *Additional tuned circuits may be added at any time without removing the Tuner from the receiver.*

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There is no need to dismantle the tuner or return it to the Factory for any part of this operation.

4 *Wiring reduced to an absolute minimum thereby eliminating stray capacities.*

Stray capacities between wiring can lead to serious mistuning on the very high frequencies of Television Band 3. The Ediswan Clix Tuner is designed so that wiring is reduced to an absolute minimum and materials are specially selected to overcome the problems of drift and instability encountered on these frequencies.

5 *Suitable for mounting in deep or shallow chassis.*

Four 4BA tapped holes are provided for mounting the Ediswan Clix Turret Tuner. If required, suitable mounting brackets can be provided for use in shallow chassis.

Flywheel Synchronizing

3.—*Balanced A.F.C. Systems*

By W. T. COCKING, M.I.E.E.

It was said in Part 2 that phase discriminators could be divided into two broad classes—the balanced and the unbalanced. A rather brief description was given of one form of the latter. The balanced types are probably the more widely used, however, and there are good reasons for this to which we shall return later.

The commonest form of balanced phase discriminator is shown in Fig. 1. It comprises a pair of diodes fed in push-pull with one signal and in parallel with the other, so that one diode operates on the sum of the signals and the other upon their difference. The usual practice is to feed the sync signal in push-pull and the local signal in parallel; there are theoretical advantages, but practical disadvantages, in reversing this arrangement and making the local signal the push-pull one.

The usual arrangement of push-pull sync pulses is adopted in Fig. 1. The transformer T is connected in the anode circuit of the sync separator and is fed with the sync pulses as a current waveform. The secondary is centre-tapped to provide a push-pull output and is loaded by the two resistances R. The transformer is designed to act in conjunction with these resistances as a differentiating circuit and so differentiated sync pulses appear as a voltage waveform across the secondary. The transformer and the resistances R are commonly used in commercial practice, but they are not necessary, for they can be replaced by an RC circuit and a phase-splitting valve and this is often more convenient in that it does not call for any special component.

A saw-tooth voltage waveform which is obtained from the time-base and which is positive-going on the flyback and negative-going on the scan is applied across R_4 in Fig. 1. This wave has no d.c. component so that it passes through zero twice per cycle, once during the flyback and once during the scan.

When a sync pulse occurs, A becomes positive to E and B negative to E by equal amounts. If it so happens that at this instant the saw-tooth is passing through zero, point G is at the same potential as E. Then V_1 conducts on the voltage provided by the upper half of T and V_2 conducts on the voltage provided by the lower half. The charging current for C_1 flows round the path C A E G C for V_1 and round the path G E B D G for V_2. The currents in R_3 are equal and opposite and so cancel. When the diodes cease to conduct, C_1 discharges by the path C F E A C and C_2 by the path D F E B D. In practice, C_1 and C_2 are made of the same value and R_1 and R_2 are also alike. Therefore, C_1 and C_2 become charged to equal voltages and so the discharge currents in R_3 are equal and opposite and cancel. No voltage is developed across R_3 and the output is zero.

If the instantaneous value of the saw-tooth at G is not zero when the sync pulse occurs, but is at some positive potential so that G is positive to E, then when the diodes conduct this voltage opposes the input to

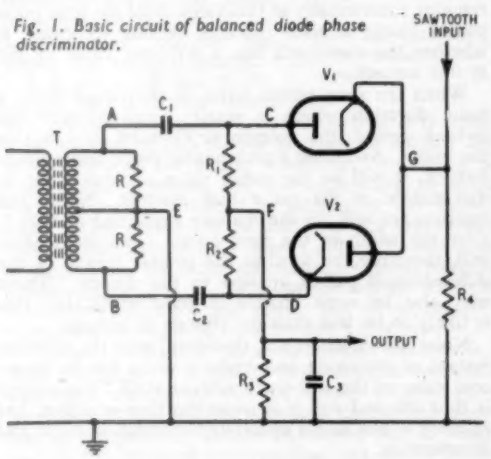

Fig. 1. Basic circuit of balanced diode phase discriminator.

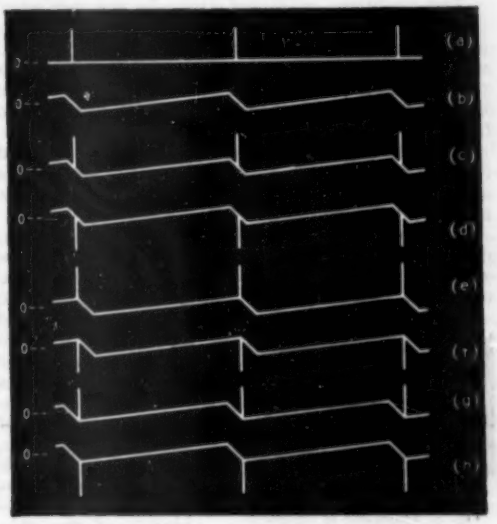

Fig. 2. Idealized waveforms for the circuit of Fig. 1. The sync pulses (a) and the waveform (b) are summed in (c) and (d) to show their combined effect on the two diodes when the relative phase difference is zero. The two extremes of phase difference are indicated in (e) and (f) on the one hand and (g) and (h) on the other.

V_1 but assists the input to V_2. Therefore, C_1 is charged less and C_2 more than when G is at zero potential. The subsequent discharge current of C_2 round D F E B D therefore exceeds the discharge current of C_1 round C F E A C. The difference between the currents produces a voltage drop across R_2, making F positive to earth. Similarly, if G is negative when the valves conduct, V_1 passes a greater current than V_2. The discharge current of C_1 then predominates over that of C_2 and the potential of F becomes negative to earth.

In practice, the input at G is a saw-tooth without a d.c. component. Ideally, it would pass through zero at the mid-point of its flyback. No output is obtained if the sync pulses coincide with this zero of the waveform, but a positive output is obtained if they occur at a time when the saw-tooth is positive or a negative output if they occur at some other time when it is negative.

Phase Relations

The conditions are illustrated in a simplified manner in Fig. 2. It should be noted that the saw-tooth is shown here reversed in phase compared with Fig. 1 because, for simplicity, it is drawn as if it were applied to the transformer centre-tap instead of to the junction of the valves. The line pulses are indicated at (a) by the thin vertical lines and the saw-tooth is shown at (b), the two being at the correct position of zero relative phase. At (c) and (d) are the sum and difference of (a) and (b). The sync pulses coincide with the moments when the saw-tooth passes through zero and so the saw-tooth adds nothing to them. Both (c) and (d), therefore, show waves of the same peak value, one positive and the other negative. Both detectors pass the same current and the output is zero.

The conditions in (e) and (f) are for the case when the saw-tooth is of different phase so that the sync pulses just coincide with the start of its flyback. If we reckon the peak-to-peak saw-tooth amplitude as one unit, so that the pulse amplitude is 2 units, then in (e) the peak value of the wave is $+2\frac{1}{2}$ units and in (f) it is $-1\frac{1}{2}$ units.

The other extreme condition is shown in (g) and (h) with the saw-tooth so phased that the sync pulses occur at the end of its flyback. Here the peak values are $+1\frac{1}{2}$ units and $-2\frac{1}{2}$ units respectively.

Over the extremes of phase shown, the input to one detector varies from $+2\frac{1}{2}$ units to $+1\frac{1}{2}$ units while the other varies from $-1\frac{1}{2}$ units to $-2\frac{1}{2}$. The combined output is proportional to the difference between them and so varies from $+1$ to -1. The magnitude of the output varies with the peak-to-peak amplitude of the saw-tooth and is, to a first approximation at least, independent of the amplitude of the sync pulses, provided that they are the greater.

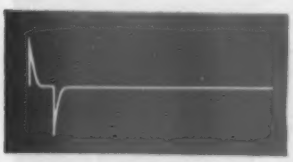

Fig. 3. Waveform of differentiated line sync pulse.

In practice, the sync pulses will be wider than is shown in Fig. 2 and they will normally be accompanied by reverse pulses 10 μsec later, corresponding to the ends of the original pulses. The greater width is not very important as long as the pulses are of a good deal shorter duration than the flyback of the saw-tooth. The reverse pulses are quite unimportant for, when they occur, the diodes are non-conductive and they are in the wrong sense to make them conduct again. The fact that the sync pulses are rather like Fig. 3 actually makes very little difference.

In the circuit of Fig. 1, it is the usual practice to make $C_1=C_2=0.001\,\mu F$, $R_1=R_2=100\,k\Omega$ and $R_3=2\,M\Omega$, while the other resistors are of relatively low value. When the diodes are conductive on the pulses, the charging time-constants of C_1 and C_2 are quite small. They are governed by the values of R and the diode resistance, which may total 5–10 kΩ only. The charging time-constants are thus of the order of 10 μsec or less. There are two different discharging time-constants. The first governs the rate of discharge of C_1 and C_2 and so the voltage changes at C and D of Fig. 1 relative to earth when the diodes are non-conductive. This is approximately C_1R_1 and is 100 μsec—the line period. The time-constant for the output voltage is much longer, even if the effect of C_3 is ignored, and it approximates to $2C_1R_3$. It is about 4,000 μsec in practice and, taking C_3 into account, it is considerably greater.

The waveform at C of Fig. 1 relative to earth is of the kind sketched roughly in Fig. 4 and that at D is its inverse. This diagram is not to the same scale as the others.

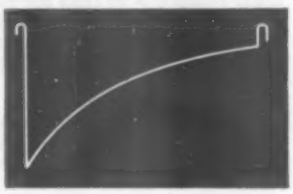

Fig. 4. Waveform at point C of Fig. 2.

It will be seen that the sync pulses act as a kind of gating waveform to make the diodes conduct when they occur. The actual output of the circuit depends on the instantaneous value of the saw-tooth at the instant when the pulses occur.

It is possible to imagine the circuit as being a kind of switching device which joins G and F whenever a sync pulse occurs. The output voltage, therefore, is brought to whatever is the instantaneous value of the saw-tooth at the moment the sync pulse occurs. Because of the time-constant C_3R_3, the voltage remains substantially at this value until the next pulse comes along; it then changes or not according to whether the saw-tooth has a different value or not at this instant.

When the sync pulses have, as they must have, a finite duration which is small compared with the flyback period, the voltage at G must vary during the pulse. Assuming a rectangular pulse and a linear flyback, it will be the mean value corresponding to the middle of the pulse that matters. Noise and interference will, in the manner explained in Part 1, alter the width of the sync pulse. The main effect will, therefore, be to alter the precise timing of the differentiated pulses applied to the diodes. There may also be some change in their width, but this is likely to be less than the change of timing.

Noise and interference, therefore, alter the effective instant of switching and make it occur for an incorrect value of the saw-tooth voltage at G. The output is thus affected and it is upon the time-constant that reliance is placed for reducing the effect of noise and interference.

In one particular case, however, the balance of the circuit gives immunity. If the conditions are adjusted to be of mean phase, so that the saw-tooth passes through zero when the sync pulse occurs the discriminator output is zero. If then a burst of severe interference comes along which obliterates the sync pulse completely, the diodes do not operate, the output remains zero and the time-base remains quite unaffected. With less severe interference, which produces a delayed pulse, the diodes conduct later than they should do and an unwanted output appears.

One defect of the circuit is obvious. Spurious pulses occurring at almost any time can cause diode conduction and so affect the output. Such pulses can be due to noise and interference and will certainly occur at half-line intervals during the frame pulses.

It appears to be wrong in principle, therefore, to use as the gating waveform one which is subject to irregularities and it would seem much better to use the local waveform for gating. This can be done in Fig. 1 by reversing the signals; that is, by applying the local waveform in push-pull by T and the sync pulses in parallel across R_1. The practical difficulty is that it is not so easy to develop the required waveforms but, if it can be done, the circuit becomes quite immune to any interference except that which occurs while the diodes are made conductive by the local gating pulses.

The question now arises as to what are the best waveforms for this kind of operation. The gating pulses should obviously be narrow and should occur at some little time after the time-base flyback has started. The flyback pulse clearly suggests itself as a possibility since it occurs at about the right time and is available with ample amplitude. It is, however, inclined to be on the wide side.

The sync pulse waveform is more difficult. It should have a sloping part of more or less regular slope with equal positive and negative values and would, ideally, be like Fig. 5 with its start and finish corresponding to the beginning and end of a line sync pulse. It cannot be generated by making use of the two ends of the pulse, however, otherwise there will be a change of waveform during the frame pulse period; it is only the leading edges of the line pulses that recur regularly.

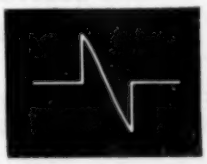

Fig. 5. Sync-pulse waveform required for ideal operation.

It is not at all easy to design a simple circuit which will produce the required waveform and it is probably because of this that it is usual to employ the sync pulses as the gating waveform. Returning to this system, therefore, the saw-tooth input to R_1 in Fig. 1 is usually obtained by integrating the voltage pulse which occurs on the anode of the line output valve during flyback, or a related pulse obtained from a tapping on the scan transformer. This pulse is positive-going and of large amplitude, so that the integration is simple and cheap and rarely involves more than a couple of resistors and capacitors.

The precise form of the phase detector has an effect upon the degree of immunity to interference and noise and upon whether or not the change of sync-pulse waveform during the frame flyback distorts the upper part of the picture. It also affects the pull-in range; that is, the range of free-running frequencies of the time-base over which the circuit will lock in, when sync pulses are applied. Generally speaking, the balanced type of detector is to be preferred to the unbalanced. When the time-base happens to be correctly adjusted it gives no output, so if the sync pulses cease the time-base frequency is not altered. An unbalanced detector, when correctly adjusted to the mean condition, gives quite a large output, so that if the sync pulses cease the time-base changes frequency by quite a large amount and it may not pull into step again when the pulses re-appear. It may be necessary to adopt special means for making it lock-in again.

In any case, however, a time-base can pull into synchronism only over a limited range of frequency difference—the lock-in range. Once locked, however, it may hold in over a much wider range of control settings. One can have the condition, therefore, that the time-base will remain locked as long as the sync pulses persist, but lose synchronism and refuse to lock again (without manual adjustment of the hold control) if they are interrupted for a short interval.

Stability

The lock-in range depends mainly upon the time-constant of the circuit. If this is made large to secure good noise reduction the lock-in range becomes small. This is fairly obvious because the circuit is a low-pass filter. When a difference of frequency exists between the sync pulses and the time base, this difference frequency must be passed by the filter if there is to be any control voltage acting on the time-base. The larger the time constant is made, the lower is the difference frequency which is passed with any effectiveness.

Once the time-base is in synchronism, however, it can remain locked for quite large changes of the values provided that they occur slowly, for slow changes are passed by the filter.

Because of these effects it is often necessary to take special precautions in the design of the time-base to ensure that its free-running frequency remains within quite narrow limits. In the ordinary directly-locked time-base the free-running frequency is normally several kilocycles below the locked frequency and quite large variations are permissible. It is quite normal for a receiver to operate for months without the hold control being adjusted.

The tuned-circuit type of flywheel-sync system described in Part 1 behaves in the same way as the directly locked time-base in this respect. In fact, the time-base is locked in the ordinary way by pulses. The flywheel circuit acts to generate noise-free pulses. With flywheel sync of the a.f.c. type, however, the permissible variation of frequency is relatively very small and may be a few hundred cycles only, if the time-base is to lock-in reliably without manual adjustment. Apart from effects due to the ageing of valves and components, the chief causes of frequency changes are temperature and supply voltage. Some form of stabilization is usually needed and it is common to include a tuned circuit in the time-base as an aid to frequency stability.

It has already been mentioned that all forms of a.f.c. systems are negative-feedback circuits. In the closed loop formed by the phase detector, the filter and the time-base, there are several time-constant circuits in cascade and there is gain around the loop. It is possible, therefore, for the system to go into oscillation

at some frequency. The trouble arises through the time delay around the loop. If some change occurs, the response of the circuit, which should act to correct it, does not occur straight away but is delayed by the time-constants of the circuits. The change remains for a time uncorrected and a large correction voltage is built up. When this does start acting it may be excessive for the change existing at that moment and cause over-correction.

It is almost invariably necessary to include a stabilizing circuit which acts to reduce the phase-shift around the feedback loop. In servo nomenclature, it is an anti-hunt circuit and it results in the output of the filter containing a component proportional to the rate of change of phase as well as to the phase difference between the sync pulses and time-base voltage.

Typical Circuit

One form of this is shown in Fig. 6. This diagram shows a complete a.f.c. circuit of the balanced diode type and should be compared with Fig. 1; similar components in the two diagrams bear the same reference letters. In Fig. 6, differentiation of the sync pulses is carried out by C_7R_7 and the push-pull input to the diodes is obtained from the phase-splitter V_3. This is an alternative to the transformer of Fig. 1.

The saw-tooth is obtained by integrating the pulse on the line output circuit by R_6, R_4 and C_4 in combination, C_6 being merely a d.c. blocking capacitor. The components R_5C_5 form the main filter for interference reduction and C_3 is for stabilizing the circuit. An alternative arrangement is to omit R_5C_5 and make C_3 rather larger and then to connect in shunt with C_3 the series combination of a resistor and a capacitor for stabilizing.

A drawback of having to include these stabilizing components is that since, of necessity, they make the filter respond more quickly to a change of input they do also reduce the effectiveness of the filter against noise and interference. They do not do so in quite the same way as a simple reduction of the time-constant would do, of course.

In all flywheel sync circuits, whether of the tuned circuit or the a.f.c. type, the noise and interference reduction is obtained by means of high selectivity in some form, so that the time-base is affected only by the cumulative effect of many sync pulses. It would appear to be ideal to make the selectivity so high (that is, the time-constants so long) that the integration effect persisted over several frames. Any break-up of the picture or displacement of the lines would then be impossible and noise or interference could affect things only by causing a small and very slow sideways movement of the picture as a whole. This would be hardly noticeable.

Unfortunately, it is found in practice that this is not always practicable because the sync pulses themselves do not recur sufficiently regularly. This is especially the case with outside broadcasts and, if the time-constant is made too great, the picture may have curved sides. In practice, it is often necessary to restrict the integration period to quite a few lines only. As a result, a certain amount of line displacement can occur. It is, however, of a less troublesome character than with direct-locking. Lines do not tear out in an irregular manner, but a group of lines may move slightly sideways in a smooth fashion so that a vertical line in the picture may develop a small bulge.

When only a moderate time-constant is used, trouble may be experienced from the half-line pulses which occur during the frame pulse. These will inevitably cause a change of output unless the phase discriminator is of a type which does not respond to them or unless the integrating time constant is so great that the output cannot change appreciably. In other cases, the time-constant must be small enough to enable the output to recover after the change before the picture modulation starts.

In view of the drawbacks of flywheel sync (namely, its greater complexity, the need for a more stable time-base, the movement of the picture as a whole with any change, and the limited noise immunity imposed by transmitter effects) the writer's view is that its use is not worth while under normal receiving conditions, in which receiver noise is negligible and external interference is small. There is, however, no doubt at all that it is very much worth while in poor locations where interference is serious or where the signal is so weak that receiver noise is important.

It is quite important not to be misled by foreign practice. The fact that flywheel sync is universal in the U.S.A. and is widely used on the Continent is quite irrelevant, because their television systems employ negative modulation whereas the British practice is to use positive modulation.

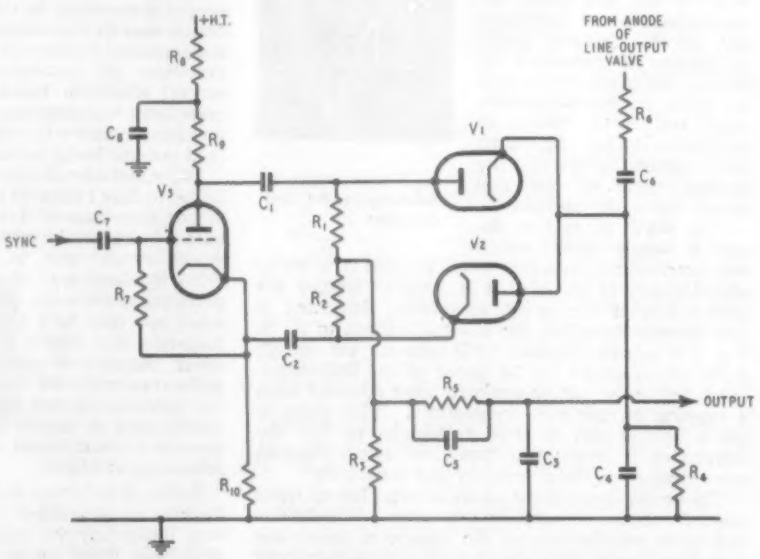

Fig. 6. Complete a.f.c. circuit using a phase-splitting input valve and showing the anti-hunt capacitator C_5.

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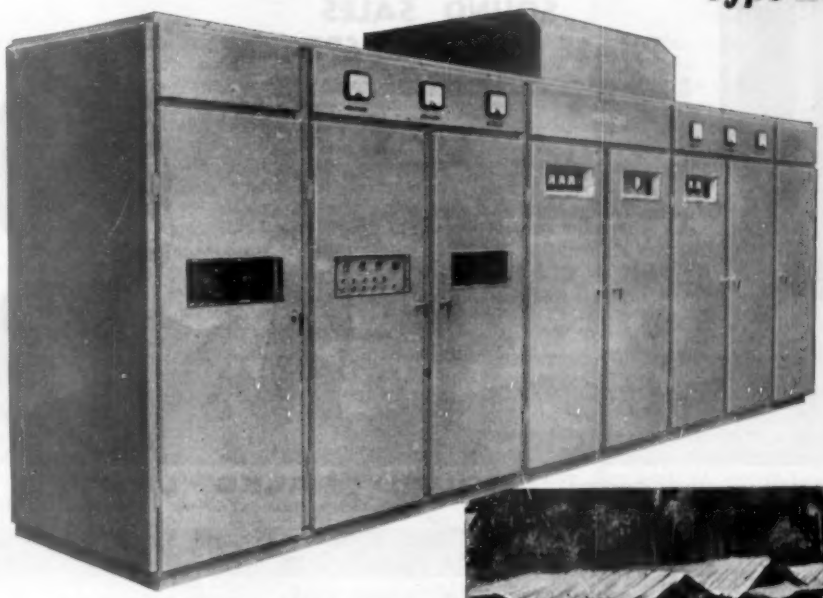

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I.E.E. Discuss the Future of Colour Television in Britain

NOT very long ago any mention of the word "non-compatible" in connection with colour television was considered almost indecent. In America the C.B.S. non-compatible frame sequential system had been tried and had proved a miserable failure, and everybody was pouring scorn on the F.C.C. for bringing it into operation. The wonderful new N.T.S.C. compatible system was introduced shortly afterwards and we all (or, at least, most of us) felt that this compatibility—a fascinating new idea—was the only sensible thing to have.

Since then it appears that radio technical people in Britain have been pondering rather deeply over compatibility and all it implies, and as a result there has been quite a strong reaction against it. The main objections seem to be that when you shackle a new system (colour) to an existing old one (the present 405-line monochrome system) you are not only making things difficult for future generations of receiver designers, but putting a stop to the development of new colour systems. Moreover, the compatible system which has now been tried out in America has not proved quite so successful as was at first hoped, and it appears to have one or two technical disadvantages, such as "buzz" on sound and dot patterns on the screen, which would not be very acceptable in this country.

At the moment, then, there is quite a division of opinion on compatibility, and it was probably this that gave rise to the recent discussion at the I.E.E. on "whether compatibility is necessary for a colour television system in Great Britain." Most of the contributions to this discussion were naturally concerned with engineering matters. It is doubtful, however, whether these helped to clear the air, for the whole issue of compatibility versus non-compatibility is really bound up with economic and political considerations. For example, in commercial television, whether here or in America, the programmes have to reach the largest possible number of people, so compatibility is almost an essential. With an organization like the B.B.C., however, there is no pressure from commercial interests and they can afford to develop a non-compatible service, with quality as the main criterion, even if there are very few people capable of receiving it at first.

Systems and Apparatus

But what exactly are the engineering considerations? What do "compatibility" and "non-compatibility" really mean in terms of systems and apparatus? At the moment a compatible system for Britain is generally taken to mean an adaptation of the American N.T.S.C. system,* and, according to opinions expressed at the I.E.E. meeting, no other compatible system is likely to be developed. As is well known (and was admitted at the meeting), the N.T.S.C. system has a degrading effect on the vision and sound of black-and-white receivers because of interference from the colour sub-carrier. There is a general opinion, too, that this would be worse in Britain than in America owing to the superior video response of our receivers and the fact that the lower frame repetition frequency would not allow such effective cancellation of the sub-carrier dot pattern by the viewer's eye. A partial solution would be to degrade the bandwidth of our receivers to just over 2 Mc/s. Another problem mentioned at the meeting was that the N.T.S.C. system requires asynchronous operation (not locked to the mains), which would produce a visible beat effect on the screen as a result of interaction between the mains and the frame frequency.

"Adjacent-channel" Scheme

Most of the drawbacks of the ordinary N.T.S.C. system can be overcome by transmitting the troublesome colour information in an adjacent channel—an expedient which has already been demonstrated on a 405-line closed-circuit system.† This could still be considered as a compatible system suitable for Bands I and III, but it would be necessary for the "adjacent-channel" colour signals to overlap the monochrome signals of another station. Thus there would still be a risk of interference. However, the idea has not yet been proved impracticable (at least in this country), so it remains an interesting possibility.

By moving the "adjacent-channel" system into Band IV and occupying a channel width of 7-8 Mc/s to avoid overlapping, the problem of interference could be overcome completely. This would then provide a compatible colour service in the u.h.f. region—as was advocated by one speaker at the discussion. Existing Band-I monochrome receivers would not be able to receive the programmes (except with the addition of converters), but all new monochrome sets could be designed from the beginning for Band IV reception.

There is a general feeling, however, that any colour system put into Band IV would probably take full advantage of the wider channels available (the T.A.C. have suggested 7.5-Mc/s channel widths) and work on a higher definition—possibly 625 lines. The proposal was, in fact, put forward at the I.E.E. discussion by the opener, E. P. Wethey, who envisaged a 625-line non-compatible system with "adjacent channel" colour operating in Band IV. Mr. Wethey pointed out that this could, in a sense, be made compatible by using a standards converter to change the 625-line pictures to 405-line pictures, so that they could be transmitted in Bands I and III and received by existing monochrome receivers. An incidental advantage of the 625-line standard, also mentioned at the meeting, was that it would facilitate programme exchanges with the Continent. A speaker who had had wide experience of compatible colour television in the U.S.A., however, maintained that the cost of

* *Wireless World*, November, 1953, p. 524.

† *Wireless World*, June, 1954, p. 256.

introducing a non-compatible 625-line system in Band IV would be prohibitive.

When talking of non-compatible colour systems, then, it appears that engineers are concerned mainly with the use of wider channels in Bands IV and V, possibly higher definition, and probably "adjacent-channel" colour signals. Thus one important principle of the American compatible system has not been thrown overboard—the idea of transmitting the brightness information and the colour information separately. This is now generally felt to be a good thing. If it comes to be regarded as an essential there is no hope for the old frame-sequential system, which is still considered a possibility for non-compatible colour transmissions. (This does not necessarily mean rotating colour filters at the receiver; tricolour c.r. tubes can be used equally well.) The frame-sequential system gives good colour pictures and is simple in operation, but, unfortunately, is rather wasteful of bandwidth as it transmits a certain amount of redundant information.

The question of bandwidth is, indeed, one of the main problems with non-compatible systems, and it came in for a good deal of discussion at the I.E.E. meeting. There is some difference of opinion on whether receivers with wide bandwidths are expensive to manufacture. It was, however, agreed at the discussion that signals occupying a band of 7-8 Mc/s would increase the cost of programme distribution by cable and radio link. A more important problem is that radio transmission systems with wide bandwidths are more susceptible to the effects of multi-path propagation, and this would no doubt have a bad effect on colour phasing in the television pictures. It could be argued, too, against non-compatible colour systems, that they would take up valuable space in the ether, while compatible systems would make use of the existing television frequency allocations. (The general reaction of television engineers to this is: if *we* don't take the available space then somebody else will!)

Finally, there are the general problems of transmission and reception in Bands IV and V. At the moment there is very little data available on the coverage obtainable from transmissions at these frequencies and Band IV receivers are only in the experimental stage. However, it was suggested at the discussion that by the time we are ready for colour television most of these difficulties will have been overcome.

INTERNATIONAL RADIO RESEARCH

Summary of the Recent U.R.S.I. Meetings

SOME 300 delegates from twenty-one countries attended the 11th General Assembly of the International Scientific Radio Union (U.R.S.I.), which was held in The Hague from 23rd August to 2nd September. The two main functions of the Union are: (1) to promote and organize research requiring international co-operation and (2) to promote the setting up of common methods of measurement and the standardization of measuring equipment. The work of the Union is carried on by eight commissions, each concerned with a specific aspect of radio research.

Reference is made on p. 590 to a resolution on the velocity of radio waves made by Commission I (measurements and standards) which met under the chairmanship of Dr. R. L. Smith-Rose, who is also vice-president of the Union. This commission also decided to arrange for the international comparison of standards for measuring power at frequencies of 3,000 and 10,000 Mc/s, and to assist the International Radio Consultative Committee (C.C.I.R.) in observations of the reception of standard frequency transmissions from various countries.

Dr. C. R. Burrows (U.S.A.) was chairman of Commission II, which is concerned with the propagation of waves through the troposphere. Here the importance was stressed of studying propagation conditions in the v.h.f. and u.h.f. bands, in several parts of the world and under various meteorological conditions. Detailed knowledge is required as to the manner in which the received field strength is dependent upon the season, geographical location and the length of path and nature of the terrain over which the signal travels.

The meetings of Commission III were presided over by Sir Edward Appleton, and they dealt with various problems associated with the propagation of radio waves through the ionosphere. An important part of the proceedings and the associated resolutions, was concerned with the detailed arrangements being made for world-wide observations to be undertaken during the International Geophysical Year of 1957-58. On certain days of each month during that year, all nations in a position to do so will carry out an intensive series of measurements of various atmospheric and terrestrial phenomena. A corresponding programme was also recommended by Commission IV, which, under the chairmanship of J. A. Ratcliffe, deals with atmospherics of terrestrial origin. The discussions at the meetings of this commission ranged over the subjects of the waveforms of atmospherics, "whistlers" and the measurement of the noise level which prevails in various parts of the world.

Radio waves which arise from sources external to the earth's atmosphere are the concern of Commission V (Radio Astronomy), which held meetings under the chairmanship of Dr. M. Laffineur (France). Here the radio scientist has developed a new field of research since the war, in which a great deal of knowledge has already been obtained on the radiation from the sun and stars at various frequencies above 30 Mc/s. Improved techniques of reception have resulted from work in this country, as well as in Australia, Holland and U.S.A. Members of the commission have been responsible for the recent publication by U.R.S.I. of three special reports in this field. These have considerably enhanced our knowledge of the distribution of radiation from the sun, and also of the distribution of neutral hydrogen atoms, which are identified by their characteristic line radiation at 1420 Mc/s.

The remaining two commissions of the Union held a number of discussions on subjects in the fields of radio waves and circuits (VI) under Professor S. Silver (U.S.A.), and radio electronics (VII) under Professor G. A. Woonton (Canada). A wide range of subjects was dealt with including information theory, and various aspects of circuits, aerials and wave-guides.

The Proceedings of the Hague meetings will be published by the General Secretariat of U.R.S.I., 42 rue des Minimes, Brussels, from whom previous publications, including the special reports mentioned above, can also be obtained. The next meeting of the Assembly will be held in 1957 in Boulder, Colorado, U.S.A. R. L. S.-R.

DECEMBER MEETINGS

Institution of Electrical Engineers

London.—December 1st. "The Vertical Radiation Patterns of Medium-Wave Broadcasting Aerials" by H. Page and G. D. Monteath.

December 6th. Discussion on "The Applications and Limitations of Electronic and other Computors" opened by Dr. L. G. Brazier.

December 13th. Discussion on "Practical and Economic Problems in the Maintenance of Domestic Television Receivers" opened by W. L. Greenwood.

All the London meetings will be held at 5.30 at Savoy Place, W.C.2.

East Midland Centre. — December 16th. Faraday lecture "Courier to Carrier in Communications" by T. B. D. Terroni at 6.30 at the Albert Hall, Nottingham.

Cambridge Radio Group.—December 7th. "Transistor Circuits" by E. H. Cooke-Yarborough at 6.0 at the Cambridgeshire Technical College.

Mersey and North Wales Centre.—December 6th. Faraday lecture "Courier to Carrier in Communications" by T. B. D. Terroni at 6.45 at the Philharmonic Hall, Liverpool.

North-Eastern Radio and Measurements Group.—December 2nd. "Radio Stars" by R. Hanbury Brown at 7.0 at King's College, Newcastle-upon-Tyne. (Joint meeting with Newcastle-upon-Tyne Astronomical Society.)

December 6th. "An Investigation of the Characteristics of Cylindrical Surface Waves" by Prof. H. E. M. Barlow and A. E. Karbowiak, and "Surface Waves" by Prof. H. E. M. Barlow and Dr. A. L. Cullen at 6.15 at King's College, Newcastle-upon-Tyne.

South-East Scotland Sub-Centre.—December 7th. "Technical Arrangements for the Sound and Television Broadcasts of the Coronation Ceremonies" by W. S. Proctor, M. J. L. Pulling and F. Williams at 7.0 at the Carlton Hotel, North Bridge, Edinburgh.

South Midland Centre.—December 6th. "Technical Arrangements for the Sound and Television Broadcasts of the Coronation Ceremonies" by W. S. Proctor, M. J. L. Pulling and F. Williams at 6.0 at the James Watt Memorial Institute, Great Charles Street, Birmingham.

Rugby Sub-Centre.—December 10th. Faraday lecture "Courier to Carrier in Communications" by T. B. D. Terroni at 7.0 at the Temple Speech Room, Rugby.

Hatfield District.—December 8th. "Magnetic Amplifiers" by J. F. Coales at 7.0 at the Hatfield Technical College.

British Institution of Radio Engineers

London.—December 29th. Discussion on "Education and Training of Radio Engineers" at 6.30 at the London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, W.C.1.

West Midlands Section.—December 8th. "Industrial Applications of Electronic Control" by J. A. Sargrove (Sargrove Electronics) at 7.15 at the Wolverhampton and Staffordshire Technical College, Wulfruna Street, Wolverhampton.

North-Eastern Section. — December 8th. "Logic, Algebra and Relays" by Prof. Emrys Williams at 6.0 at Neville Hall, Westgate Road, Newcastle-upon-Tyne.

Merseyside Section.—December 2nd. "Electronics in Materials Handling" by L. Landon Goodman (British Electrical Development Assn.) at 7.15 at the College of Technology, Byrom Street, Liverpool, 3.

Scottish Section.—December 2nd. "Some Interesting Applications of Electronics to Photography" by D. M. Neale (Ilford, Ltd.) at 7.0 at the Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow, C.2.

British Sound Recording Association

London.—December 10th. "Magnetic Sound Stripe Recording on 16mm Film" by W. C. C. Ball at 7.0 at the Royal Society of Arts, John Adam Street, W.C.2.

Manchester Centre.—December 13th. "Balance and Control and Acoustics" by M. R. G. Garrard at 7.30 at the Engineers' Club, Albert Square, Manchester.

Television Society

London.—December 10th. "Television Circuit Refinements" by C. H. Banthorpe (Derwent Radio) at 7.0 at the Cinematograph Exhibitors' Association, 164, Shaftesbury Avenue, W.C.2.

Royal Society of Arts

Commonwealth Section. — December 2nd. "Broadcasting in the Colonies" by J. Grenfell Williams (B.B.C. Colonial Service) at 5.15 at John Adam Street, London, W.C.2.

Institution of Production Engineers

Manchester.—December 2nd. "The Electronic Control of Machine Tools" by E. Heys at 7.15 at Reynolds Hall, College of Technology, Sackville Street, Manchester.

Incorporated Practical Radio Engineers

South Coast Section.—December 9th. "Television Servicing Equipment" by a member of the staff of Marconi Instruments at 7.30 at the Kings Arms Hotel, Castle Street, Christchurch.

North West Section.—December 6th. "Aerials for Commercial Television" by P. Jones (Aerialite) at 7.30 at the Barley Mow Hotel, Turner Street, High Street, Manchester, 4.

CLUB NEWS

Birmingham.—At the meeting of the Slade Radio Society at 7.45 on December 10th at the Church House, High Street, Erdington, B. V. Somes-Charlton, of Pye, Ltd., will give a survey of television camera developments and demonstrate the Pye miniature industrial camera.

Cleckheaton.—T.R.F. receivers will be dealt with by J. E. Church (G2BMC) at the meeting of the Spen Valley and District Radio and Television Society on December 1st. Members of the Bradford Radio Society will be the club's guests on the 15th, and on the 29th F. Jowett (G2FIS) will speak on superhets. Meetings are held at 7.30 at the Temperance Hall, Cleckheaton.

Newark.—At the meeting of the Newark and District Amateur Radio Society at 7.0 on December 5th at the Northern Hotel, Newark, A. Hall will talk about valve-voltmeters.

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RANDOM RADIATIONS

By "DIALLIST"

TV Extensions

MANY people like to be able to use the television receiver in either of two rooms at will. It is simple enough to make such an arrangement; but it's surprising that one should so often find the job wrongly done. "Can't understand what's amiss with my TV set," said a friend not long ago; "In the drawing room, which is right under the aerial, it gives a poor and rather jittery picture; but in my own sitting room it's as good as one could wish. Funny thing is that when it's working in my room there's about an extra 30ft of aerial cable in use: surely that shouldn't cause reception to be *better*?" You'll guess at once what I found. The feeder had been connected so that the whole of it was always in circuit. Thus, when the set was used in the drawing room the portion running to the other room formed a 30ft dead end. The proper method, which avoids all dead ends, is to connect the dipole direct to the nearer skirting-board socket, and to it alone. The far end of the extension feeder goes direct to the distant socket, its near end being fitted with a plug and clipped to the skirting board near socket No. 1. In this way the extension is out of circuit until the set is needed in the distant room, when it is connected to socket No. 1.

Suppressors Again

THE Assistant Postmaster-General is not, I fear, a reader of *Wireless World*. Had he been, he might have given a better answer to the question recently put to him in the House about the possibility of introducing legislation to make the fitting of ignition interference suppressors compulsory for *all* cars, as had been done for rear reflectors. He suggested it would "entail recruiting a corps of inspectors to go round looking at every motor car." I would remind him that it was pointed out months ago in *W.W.*, when a similar answer was given in the House, that enforcement could be effected without adding a single man to the police force. Every police car is radio-equipped, as are many police motor cycles. Any such vehicle has only to switch its v.h.f. receiver to a.m. to become an admirable detector of ignition interference. No need to take the motor patrol officers off their more important duties; all that they need to do is to turn their attention to interference detection for occasional spells. Any offending car owner would receive a notice to put things right within, say, seven days and a warning that if he doesn't do so he'll be fined next time he's caught. As no motorist could tell whether a police vehicle was or was not "detecting," I'm sure that this system would be as effective as are the P.O. detector vans against TV licence-dodgers.

A Disclaimer

Let me say at once that I don't hold shares in any of the concerns that make ignition or other suppressors. I only wish I did! Nor am I personally much of a sufferer from ignition interference. My home in the country is not near a main road and on the average the number of cars passing it during the television programmes is not more than five or six an hour. More than that, my aerial, 45 feet above the level of the road and over 100 feet from the nearest point on its surface, cannot "see" passing cars since a good solid chunk of house intervenes. More even than *that*, my aerial is 550 feet above sea level and brings in such a whacking signal from Alexandra Palace that no small amount of attenuation is required. In other words, the signal/noise ratio is pretty good. Again, though I'm keenly interested in television theory, the programmes are a very minor source of entertainment to me. With these things in mind, you'll see that so far as the effects of ignition interference on TV reception are concerned, I have few axes of my own in need of grinding. But I am deeply concerned about its adverse effects on the progress of television. Some of my friends who live on or near main roads now make little use of their television receivers. Others are not renewing their licences as they fall due. Every reader of *W.W.* who owns or drives a car has important issues at stake. If television is not his livelihood it is a major interest. I just can't and won't believe that the man who owns any sort of motor vehicle is unable to afford the shilling or two needed to prevent the slowing down of television development which must be a consequence of the prevalence of ignition interference.

Why Not Uniformity?

IT'S a mystery to me why the manufacturers of domestic television receivers can't, or at any rate don't, agree to use the same set of names for the "user" control knobs; those, I mean, that are outside the cabinet. When the completely non-technical

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man-in-the-street buys a new set, he may have to accustom himself to controls differently arranged, and with a fresh set of names for them. "Height," he understood easily enough; but what is "frame amplitude"? Is "horizontal form" the same thing as his old "line linearity"? There doesn't seem to be a knob labelled "contrast"; can "picture control" be the same thing? I needn't give further examples. Yes, I know that the dealer who installs the new set should explain the knobs and their uses. But not all dealers bother to do so. I know, too, that the buyer of a set should read the "book of words" that accompanies it. But some who start to do so don't get very far, especially if they are confronted by puzzling new names. I hope that manufacturers will get together and produce a single set of names for the controls.

Robbing Peter to Pay Paul?

FROM the Television Act, 1954, one gathered that the Independent Television Authority's annual subsidy was to be found out of the receipts from general taxation, for Section 11 of the Act reads:

"The Postmaster-General may, with the consent of the Treasury, pay to the Authority out of moneys provided by Parliament, such sums, not exceeding seven hundred and fifty thousand pounds in any one financial year, as he may with the consent of the Treasury determine."

But the section of the B.B.C.'s annual report for 1953-54 devoted to finance makes one think a bit, for it throws a rather startling light on the intended source of those "moneys provided by Parliament." Here is what it says:

"The Exchequer will retain £2,000,000 from licence revenue in each of the three years [from March, 1954] and the Post Office will receive a proportion estimated at £1,600,000 a year to cover the cost of collecting fees and dealing with interference. *In addition, £750,000 per annum will be given to the Independent Television Authority in each of its first two years of operation.* The remainder will come to the B.B.C." (The italics are mine.)

If the B.B.C. statement is correct then it is not only contrary to the Act but also to the statement made by Mr. Gammans earlier this year when announcing the increased licence fee. He then stated that by stabilizing the amount taken by the Exchequer from licence fees at £2 million it would be possible to provide the subsidy for the I.T.A. "without reducing the amount that would otherwise accrue to the B.B.C." Them's my sentiments, too!

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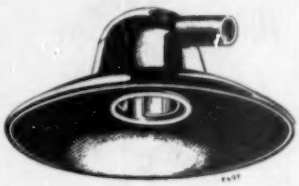

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The First Wireless Patent

ONE OFTEN HEARS elderly people talk glibly of the good old times but we have only to examine these allegedly happy days to realize that we have good cause to be thankful that we live in this present day and age. Let us, for instance, cast our minds back from 1954 to 1854 and instantly we are reminded that just a hundred years ago we went to war with Russia, whereas in 1954 all is peace between us and that great country, the giant strides of science since the carnage of the Crimea having made the very idea of war between civilized nations unthinkable.

Now all this has not the remotest connection with wireless and electronics except that when delving into the history of 1854 I came across what seemed superficially to be the first British wireless patent. It was granted to James Bowman Lindsay on June 5th, 1854, but although a "wireless" link was used there was no question of electro-magnetic waves, communication being by conduction between metal plates immersed at the opposite sides of a river.

But this patent of a hundred years ago has, at any rate, as close a link with modern wireless as has the first radar patent—granted to Hulsmeyer just fifty years ago in 1904—with modern radar technique. The real interest in Lindsay's century-old "wireless" patent is that the inventor's claims were investigated by Mr. (later Sir) William Preece, who performed the same office for Marconi nearly half a century later.

Preece didn't see any future in Lindsay's invention and pointed out to him that Morse had accomplished the same thing in the U.S.A. twelve years earlier. Contrary to popular supposition, Sir William Preece wasn't over-enthusiastic with regard to Marconi's pioneer work although he did help him considerably. On the whole I think we had better continue to celebrate June 2nd, 1896, as the date of the first British wireless patent rather than June 5th, 1854; after all, conduction and electromagnetic wave propagation are two very different things.

Points of View

FROM up North, where life is grim and earnest and not as it is in London—filled with the luxury that ruined ancient Rome, a correspondent has written to me criticizing certain aspects of the National Radio Show which displeased his practical Northern mind. He suggests that the organizers might have done worse than to visit the Manchester Business Efficiency Exhibition to see how a show should be organized and staffed.

I cannot altogether agree with him for surely the radio show—or at least that part devoted to domestic listening and viewing—should suggest joy rather than soul-destroying commerce. I, for one, like my listening and viewing to be associated with carpet slippers and an armchair and have no wish to be compelled to enjoy myself efficiently. I am also rather partial to the restful atmosphere of the radio exhibition where some of the stands, as at the Motor Show, are staffed by delightfully languid young men—real matinee idols—who couldn't care less whether I bought their firm's products or not. I prefer that to the high-pressure salesmanship horror which the

"—and thou . . ."

phrase "business efficiency" suggests to my mind. Quite frankly I'm not efficient and have no wish to be. In the words of dear old Omar, "A jug of wine, a loaf of bread—and thou . . ."

A Plea for Myriacycles

SPEAKING as one who was brought up on metres I found it as difficult to change over to kilocycles and megacycles as those brought up on feet did to change over to metres. This latter change was made, I believe, after the Berlin Radio Conference of 1903. It was, of course, all right to deal in metres in the days when wireless wavelengths ranged from about 200 metres upwards, but in these microwave days it would mean dabbling in decimals and much use of what a certain V.I.P. anathematized as "those damned dots."

Unfortunately the changeover to frequencies instead of wavelengths hasn't killed the wretched dots which cannot always be seen at a glance by those like myself who have to use glasses. Personally, I found it very irritating to study the list of frequencies of the B.B.C.'s proposed f.m. stations in the September issue of *W.W.* Not one out of the whole 27 of them was a whole number. Surely it is a mistake to use megacycles at all? The word has no numerical value in its mother tongue, whereas the word myriacycle would really mean 100,000 cycles or, in other words, 100 kc/s. The list of frequencies to which I refer above would thus range from 881 mc/s to 945 mc/s; I use the abbreviation mc/s to distinguish it from the existing Mc/s.

Apart from the foregoing argument, the word miriacycle is more euphonious than megacycles, an important point to bear in mind as we technical people surely don't want to be regarded as more uncouth and uncivilized by poets, artists and men of letters than we are at present.

Watson-Watt's Bloomer

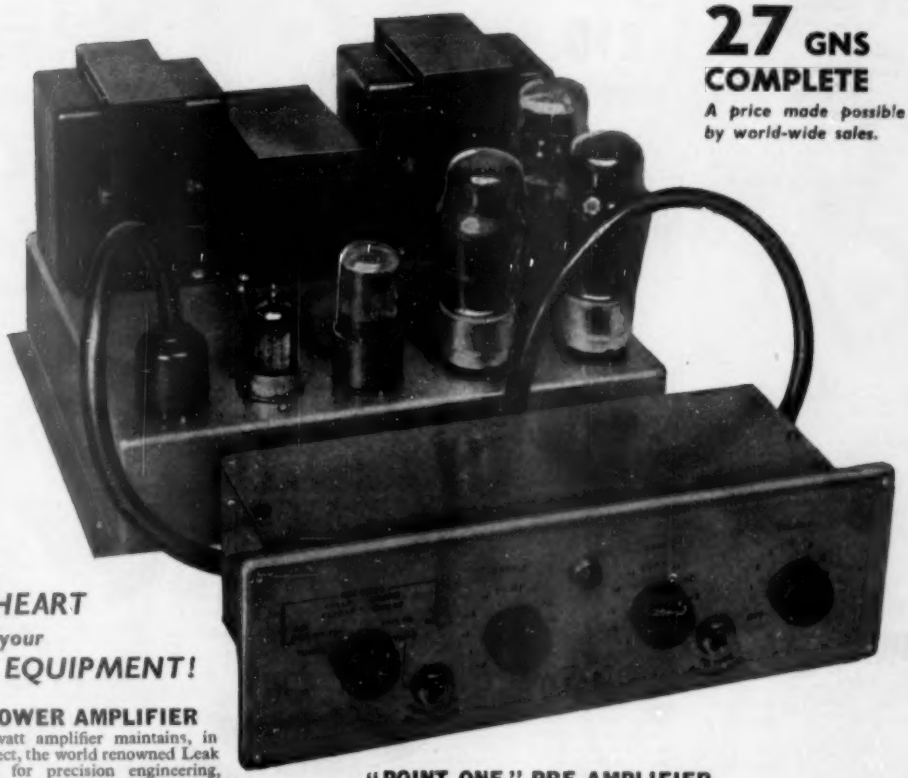
A KINDLY correspondent has sent me a newspaper cutting recording that Sir Robert Watson-Watt the radar pioneer had been fined in Ontario, Canada, for speeding after being caught in a special police trap in which use was made of the principles of radar. The *Star*, in a praiseworthy poem, compares his fate with that of Dr. Guillotine, the French physician who invented the instrument of execution which bears his name and by which he himself later suffered the extreme penalty.

I think, however, that a more homely instance of this sort of thing —although by no means so exact a parallel—is provided by the story of the late Mrs. Bloomer who, with modesty as her sole motive, invented the cycling garment which I cannot, of course, discuss in detail in the austere pages of *W.W.* She reckoned without the prejudice and prudery of the "refained" and the coarse jests of the vulgar, and so on her first outing awheel a blushing young constable was forced to escort her to the police station for her own protection. There was, in his opinion, a risk of "a breach of the peace being occasioned." It appeared that certain young bloods in the crowd with a boat-race-night mentality threatened to "debag" her, to use the jargon of a later age.

The NEW LEAK TL/10 AMPLIFIER & "POINT ONE" PRE-AMPLIFIER

27 GNS COMPLETE

A price made possible only by world-wide sales.



★ *Make this*

THE HEART of your HI-FI EQUIPMENT!

TL/10 POWER AMPLIFIER

This 10 watt amplifier maintains, in every respect, the world renowned Leak reputation for precision engineering, fine appearance and fastidious wiring.

SPECIFICATION

Circuitry
A triple loop feedback circuit based on the famous TL/12. The output transformer is the same size as in the TL/12.

Maximum power output: 10 watts.

Frequency Response: ± 1db 20 c/s to 20,000 c/s.

Harmonic Distortion: 0.1%, 1,000 c/s, 7.5 watts output.

Feedback Magnitude: 26 db, main loop.

Damping Factor: 25

Hum: —80 db referred to 10 watts.

Loudspeaker Impedances: 16 ohms, 8 ohms, and 4 ohms.

"POINT ONE" PRE-AMPLIFIER

The handsome gold escutcheon plate contributes to the elegant appearance, and blends with all woods.

★ **Pickup**
The pre-amplifier will operate from any pickup generally available in the world. A continuously variable input attenuator at the rear of the pre-amplifier permits the instantaneous use of crystal, moving-iron and moving-coil pickups.

★ **Radio**
The radio input sockets at the rear permit the connection of the LEAK V.S. tuner unit. An input attenuator is fitted. H.T. and filament supplies are available from the pre-amplifier

★ **Distortion**
Of the order of 0.1%.

★ **Hum**
Negligible, due to the use of recently developed valves and special techniques.

★ **Input selector**
Radio, tape, records; any and all records can be accurately equalised.

★ **Treble**
Continuously variable, + 9 db to — 15 db at 10,000 c/s.

★ **Bass**
Continuously variable, + 12 db to — 13 db at 40 c/s.

★ **Volume Control and switch**
The switch controls the power supply to the TL/10 power amplifier.

★ **Tape Recording Jacks**
An exclusive feature. Readily accessible jacks are provided on the front panel for instantaneous use with Tape Recorders which have built-in (low level) amplifiers.

★ *Write for leaflet W* ★

H. J. LEAK & CO. LTD., BRUNEL ROAD, WESTWAY FACTORY ESTATE, ACTON, W.3

'Phone: SHEpherds Bush 1173/4 *Telegrams: Sinusoidal, Ealux, London* *Cables: Sinusoidal, London*

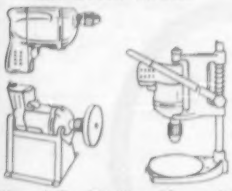
THE SUPERIOR 15in.

up to the minute big picture TV for only £37 10s., A 20-valve televisor for the amateur constructor, all components, valves and 15in. Cossor Cathode Ray Tube costs £37 10s., plus £1 carriage and insurance or £12 10s. deposit and 12 monthly payments of £2 11s. 6d. Constructor's envelope giving full details and blueprint, 7/6. Returnable within 14 days if you think you cannot make the set.

22/6 FLUORESCENT LIGHTING

Kit comprises 40 watt control unit, starter lamp, lamp holders, clips and wiring diagram. Price, less tube, 22/6, plus 1/6 post. With tube, 30/-, plus 3/6 carr. and insurance.

SENT FOR £1 ONLY
BLACK AND DECKER ELECTRIC TOOLS



¼in. drill, £5 19s. 6d. or £1 deposit. Bench stand for drill, £3 7s. 6d. Lathe stand for drill, £5 5s. or £1 deposit. The three items supplied for £14 12s. or 43/- deposit.

PLUGS FOR MODERN VALVE HOLDERS Each is fitted with a rubber shroud. For B7G button base and type 2 for B8A. Price 1/4 each, discounts for quantities.

BE PREPARED

for a cold winter by making our low cost **Electric Blanket.** 27 yards of special heater wire and blueprint, 20/-. Blueprint only, 1/6. Alternatively, make a Bed Warmer. Constructional data, 1/6.

BARGAIN FOR CONSTRUCTORS

Modern style cabinet in contrasting veneers, with metal chassis, three knobs, coloured scale, and pointer. Price 29/6, post, etc., 2/-. All other components to build 2-waveband superhet. Price £5. Data, 1/6 (free with components).

THE WINDSOR 5-VALVE SUPERHET

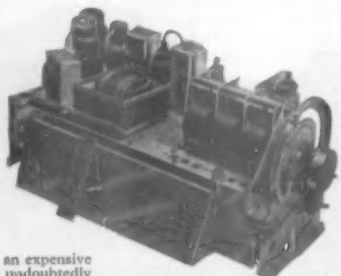
This is a 5-valve A.C. superhet covering the usual long, medium and short wavebands. It has a particularly fine clear dial with an extra long pointer travel. The latest type loctal valves are used and the chassis is complete and ready to operate. Chassis size 15in. × 6in. × 6in. Price £9 19s. 6d. complete with 8in. speaker. Carriage and insurance 10/-. H.P. terms £3 7s. deposit.

THE "WINDSOR" 5

TABLE RADIO CABINET

Due to a special purchase, we are able to offer this very fine cabinet, size approx. 15½ × 14 × 6½in.—walnut veneered and satin finished. 39/6, carriage and packing 3/6.
Note. This cabinet is the correct one for the chassis above with 6½in. speaker.

£15 VALUE FOR £5



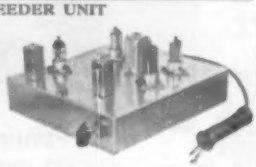
These really first-class receivers were made by one of our most famous companies for inclusion in an expensive radiogram. They are undoubtedly a serious listener's receiver. Particularly suitable in bad reception areas as they have an H.F. stage and a tuning indicator. These tune 5 wave bands including short waves up to 11 metres. We have a few only of these left as illustrated but less valves and less power pack. Otherwise in very good condition having never been used. Price £5 only, plus 7/6 carriage.

THIS MONTH'S SNIP

A SILVER STEEL TOOL ROLL

This most useful kit contains three sizes of standard screwdrivers, two sizes of Phillips screwdrivers, a taper reamer and a taper spike. All designed to slip into a 10,000-volt tested handle, and all made from specially hardened tool steel, complete in wallet tool roll. Price 12/6, post free. This is an invaluable set of tools for everyone who uses tools.

THE F.M. FEEDER UNIT



All the parts necessary to make the Denco F.M. Unit are now available. The unit gives an A.F. output suitable for feeding in at the pickup sockets of any standard broadcasting receiver and superior results can be expected. The full constructional details as prepared by the Denco technicians are available—price 1/6 post free. Alternatively, they will be given free to those ordering all the parts which come to £6 7s. 6d., plus 2/6 post and packing. Note: four valves and everything including a prepared metal chassis is supplied. Approximate chassis measurements are 6 × 6 × 1¼. Demonstrations at our branches.

BREAKDOWN PARCEL

Unit for breaking down—offered at only a little over the price of the Aladdin Coil Formers it contains. Note. All parts can easily be removed as they are all bolted together. The unit contains:—

6 Aladdin ¼in. Coil Formers with dust cores.
6 metal cans for above coil formers.
1 4-position 12-pole switch.
6 miniature R.F. chokes.
2 25-mfd. 25-v. electrolytics.
30 paper tubular condensers. .002 to .1 mostly for 450 v.
56 carbon resistors, values from ½ watt to 2 watt.
2 medium-size R.F. chokes.
7 moulded octal valve-holders.
1 moulded diode valve-holder.
20 mica condensers (moulded, silver and ceramic).
7 insulated top caps for valves.
4 components strips (one 40-way, one 11-way, one 5-way, and one 3-way).
1 very useful chassis, size 18 × 9 × 3½in.

Plus dozens of nuts, bolts, screws, washers, and other useful items such as ¼in. spindle extenders, etc.

Price only 7/6, post and packing 2/6.

CABINETS 19/6

You can make an excellent bass reflex cabinet with this well-made veneered and polished walnut cabinet. Limited quantity offered at 19/6. Carriage, etc., 3/6.

LAST FEW £3 19s. 6d.

The Lectross warms room as it dries clothes, towels, etc. Size 3ft. wide, 3ft. high and 5in. deep. Works off A.C. or D.C. mains, consuming 650 watts. Fully guaranteed. Pr. £3 19s. 6d., plus 7/6 carriage.

INSTANT HEAT CONVECTOR

4ft. long; made from heavy gauge sheet steel (galvanised), 1 kw., suitable A.C. or D.C. Price £2 or with thermostat £3 15s. Note: The thermostat mounts separately and will control up to three heaters.

'CHIMELITE'

THE CHIMELITE

It is a hall light as well as a chime and you can make it in a couple of evenings for the total cost of only 19/6, including instructions. Post, etc., 2/-. Data available separately, price 2/-.

NOW—A.C./D.C. MULTIMETER KIT

We can now offer a kit of parts suitable for making a multimeter to measure A.C. volts as well as D.C. volts, milliamps and ohms. Price for kit containing all the essential items including moving-coil meter, metal rectifier, resistors, range selector, calibrated scale, etc., is 19/6d., plus 1/- post and packing. The D.C. only version is 15/-, plus 9d. P. & P. For the benefit of those who have already made up the D.C. only version we are offering the rectifier and other parts necessary for the A.C./D.C. version as a separate kit. Price 5/6d. post free.

OCCASIONAL RADIO

Building our all-mains radio receivers is simplicity itself. Everything down to the last nut is supplied, and fits together professionally. The one above we call the "Occasional," in a choice of Ivory or Walnut and the T.R.F. costs £5 10s. to make, H.P. terms being £2 deposit.

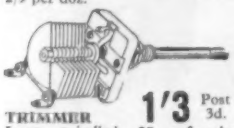
SEE OVER →

ALL MAINS THREE

A handy midget A.C./D.C. 3-valve mains receiver giving powerful reception over long and medium waves. All component parts, including valves, coils resistors, etc., but not loudspeaker and cabinet (you may already have these) will cost you only 19/6 plus 1/6 post—data available separately 2/-, post free.

1/9 Doz. Post 6d.

WIRING CLEATS
Vitreous porcelain; two groove 1/9 per doz.; three groove 2/9 per doz.



TRIMMER **1/3** Post 3d.
Long spindled 35 p.f.—also 2-gang 75 p.f. 2/3.

PORTABLE CABINET
Rexine covered. Perfect, with back and handle. Ready to take chassis. Room for batteries or power pack. Size 12in. × 10½in. × 7½in. Post and packing 2/6.

9d. Post 6d.

BULKHEAD INSULATOR
Pyrex glass with stud and fixing ring.

8/6 Post 9d.

MOVING COIL METERS
2½in. (3½in. across face), flush mounting, following types available: 0-30 mA., 0-300 mA. and 0-500 mA.

UNBREAKABLE GLASS PANELS
Size 10¾ × 9½—parcel of five panels,

5/-

3/6 Post 1/-.

CLOCK CASE
Veneered and polished—undrilled.

A WONDERFUL CHRISTMAS PRESENT

Children of all ages enjoy playing records and will be overjoyed to own the fine portable illustrated alongside. This uses the Garrard spring motor and a 2-valve battery amplifier. The case is in two-tone imitation crocodile/lizard skin. Special Price £9/17/7—carriage 7/6 extra.

THE ELPREQ NOBLEMAN

A 70 Gn. RADIOGRAM direct from makers for only 40 Gns.

Or £7 deposit.

A beautiful piece of furniture yet a most up-to-date radiogram—figured walnut lined sycamore—radio raised to comfortable level—compartment for records—5-valve A.C. mains superhet, covers long, medium and short waves—all latest refinements, negative feed-back tone control, etc.—large multi-coloured edglet dial—latest Collaro three-speed auto-changer with the famous "Studio" pick-up—plays all types of records perfectly.

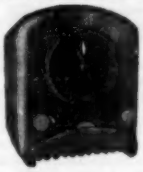
CLEVELAND TAPE RECORDER

This instrument combines the Mk. IIIU Truvex Tape Deck and the Cleveland Wide Band Amplifier with a special high flux speaker and forms one of the finest tape recorder combinations available to-day. It will, of course, play pre-recorded tapes as well as make its own recordings of radio, music, meetings, telephone conversations, letters, etc., etc. This model should be available before the end of the year and the price will be

£45

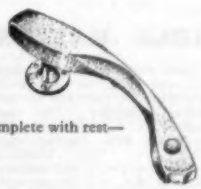
Hire Purchase terms if required.

BEDROOM-NURSERY MAINS MIDGET RADIO



All the parts, cabinet, valves, knobs, back—in fact everything will cost you only £3/15/- (plus 2/6 postage). The set is economical to run, too, for it uses only three valves in a special reflex T.R.F. circuit which gives ample power combined with good tone. Incidentally if you wish to give the sets to young children why not decorate the cabinet with a few suitable transfers? These can usually be obtained from local handicrafts shops. Circuiting and construction data free with the parts or available separately at 1/6.

GRAMOPHONE PICKUP



Electro-magnetic in bakelite case, complete with rest—a limited quantity only—

19/6

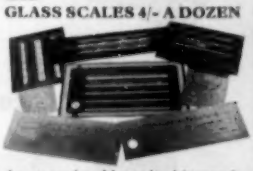
Post and packing 1/6.

A MILLIBAR BAROMETER

If you are interested in meteorology, then you will be interested to know that an article appeared in one of the leading meteorological journals showing how the Ex-R.A.F. Sensitive Altimeter can become a first-class highly sensitive yet robust aneroid barometer. We offer the sensitive altimeters in good condition with instructions at 17/6, plus 1/- postage.

A MILLIBAR BAROMETER
Note: We have a limited quantity of these altimeters complete but needing adjustment, price 7/6 each.

GLASS SCALES 4/- A DOZEN



An exceptional bargain this month is our assorted parcel of glass scales. A most useful collection for all who make up experimental or other radios. We offer twelve glass scales mostly in two or three colours for 4/- plus 9d. post and packing. Limited quantity only.

APPLIANCE LEAD
Appliance lead 7ft. 6in. long 3-core, 23/36 with thread bound prepared ends. 1/3 per lead or 12/- per dozen leads—large quantity available.

BUTTON MICROPHONE

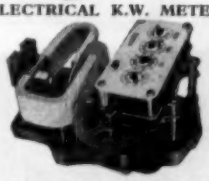
Extremely small, carbon granule type. Quantity price 15/- doz., 1/6 each.

NOVELTY RADIO
Complete tunable M/L Radio with room for 3in. speaker in base. Needs only valves, speaker and batteries, 29/6 plus 2/6 post, etc.

4-inch NAVIGATIONAL COMPASS

In wooden carrying case, but less fluid. Damaged, but repairable. 4/6 plus 1/6 post.

ELECTRICAL K.W. METER



By Ferranti. Complete works, less the case. Slightly damaged, but repairable, and contains very useful spares. 7/6 plus 2/- post.

E. P. E. LTD.

SEE OVER →

SELECTIONS FROM OUR RANGE OF CABINETS

EMPRESS CONSOLE

This cabinet is undoubtedly a beautiful piece of furniture. It is elegantly veneered externally in figured walnut, internally in white sycamore. The radio section is raised to convenient level but is not drilled or cut. The lower deck acts as the motor board, again is uncut, it measures 16 × 14 and has a clearance of 5in. from the lid. There is a compartment for the storage of recordings.
Overall dimensions of this essentially modern cabinet are 3ft. wide, 2ft. 6in. high, and 1ft 4½in. deep.
Price **£15/15/-**, carriage, etc., 12/6.

THE 1955 CORNER CONSOLE

Designed for the man who wants something really impressive. A massive cabinet but being corner fitting is not out of place even in the modern small living room. Voted by one of our leading magazines as one of the finest pieces of furniture at the 1953 National Radio Show, Earls Court. Overall dimensions of this cabinet are 47in. wide, 31in. deep (to corner), 50in. high. Note that in addition to the Superior 15 Televisor this cabinet will accommodate a radio unit with controls on the sloping panel at the top and a tape recorder, or a record player under the lid in the top. Price **£18**, plus 30/- carriage.

THE SUPERIOR 15 CONSOLE

Undoubtedly a very fine cabinet designed to house a very fine set. Handsome two-toned walnut finished and distinctive design, its modern lines blend with all furnishings. Cut out for 15in. tube and drilled to take the standard Superior 15 chassis. Price **£11/10/-**, plus 12/6 carriage.

TABLE RADIOS

We have two styles of cabinet which will take our 15 × 5 × 2 chassis and dial assembly or our Windsor Superhet. The one illustrated is the Windsor De Luxe—price **49/6**, carriage and packing 5/-. The Windsor Standard, also a very fine cabinet, is priced at **39/6**, plus 3/6 carriage.

THE BUREAU

This is a really beautiful cabinet elegantly veneered in walnut and finely polished. The control board, revealed when the front is dropped down is ample for the larger than average radio chassis or amplifier and alongside there is a space for a tape recorder or auto record changer mechanism. Both the radio board and the control board are left uncut to suit your own equipment.
Size approximately 30in. high, 32in. wide, and 16in. deep. Price **16 guineas**, carriage 12/6.

THE CONTEMPORARY

Also in the modern trend is this very stylish contemporary console. Veneered in oak with contrasting mouldings, and is ideal for use with modern furniture or with other contemporary fittings or furnishings. The radio and motor board is uncut and its size 30in. × 15½in. provides ample room for all equipment. Price **£8/15/-**, carriage etc., 12/6.

THE CONSOLE MK. II

A new design of a popular style—this is in two tone highly polished walnut veneer with nicely contrasting speaker fabric—the motor board, approximate size 30in. × 15in. is uncut so is suitable for user's own equipment—clearance to motor board is 6ins.—height of the cabinet to top of lid is 2ft. 6in. Price **£10/17/6**, carriage 12/6.

THE STATESMAN

An impressive costly looking cabinet —originally designed for projection T.V. but the projector screen can be removed very easily and the lid can be felt lined to hide the marks. This simple modification makes the cabinet suitable for radiogram, amplifier, tape recorder, or reflex speaker—size 23in. wide, 22in. deep, and 37½in. high. We have only a limited quantity of these cabinets left and we are offering them at **£8/15/-** each, which is approximately half of their manufacturing cost. Also we have a small quantity slightly damaged but easily repairable—Prices from **£7/15/-** downwards.

THE ATTACHE CASE PORTABLE

This cabinet can be supplied with radio board or with board suitable for motor pickup and loudspeaker. The board in either case is finished in the same style of material as the Cabinet proper e.g., imitation crocodile and/or lizard skin in contrasting shades. Price **37/6**, postage, etc. 3/6.

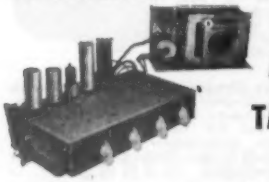
THE INFRAY LAMP

The Infray Lamp is essentially a directional infra-red radiator. It emits rays in a conical formation, the heat intensity being greatest near the lamp. The rays warm the object at which they are directed, but not the air through which they pass.

In addition to the medicinal and other functions of infra red, the Infray Lamp is especially useful in cases where it is impossible, or uneconomical, to warm the atmosphere. Thus a person working in the open could be kept comfortably warm with three or four lamps placed at convenient positions. In other cases the infra-red lamp permits considerable economy of electricity. For instance, a patient sitting in bed can be kept conveniently warm with one lamp costing only ½d. per hour to run, whereas to keep the temperature up to the same comfortable level in the average bedroom would need two 2-kilowatt fires costing 4d. per hour to run, thus the saving of electricity is really considerable. These figures are based upon electricity at one penny per unit. In districts where higher rates apply, then the saving would be even greater.

The Infray Lamp is invaluable to the farmer, poultry keeper and in fact to any breeder of animals. The young creatures will collect under the lamp for warmth and therefore are not likely to be suffocated by the mother.

The Infray Lamp has innumerable other uses to name a few:—
(1) To speed the drying of paint, cellulose, etc., for instance, in car body repairs.
(2) To dry hair and thus replace the conventional blower type drier. (3) Drying and airing of clothes. (4) In the loft to stop pipes freezing. (5) Warming food.
Price 36/-, plus 2/- post. I.R.W. Model (INFRAY MAJOR)—details on request.



AMPLIFIER FOR TAPE RECORDERS

THE CLEVELAND "WIDE-BAND"

Designed in conjunction with Truvox engineers this high-fidelity amplifier ensures that best possible results are obtained from the Truvox Mk. III as well as from other good tape decks. Two input circuits are used—these have separate volume controls and so facilitate the mixing of programme matter. Miniaturised construction is used and the dimensions of the amplifier have been kept very small and in fact only approximately a 2in. section of the control panel and cabinet is required. The power pack also is on a separate chassis so that, regardless of the type of cabinet, a position of minimum hum can be found. Hum level is very low at 50 db down for full output.

TECHNICAL FEATURES

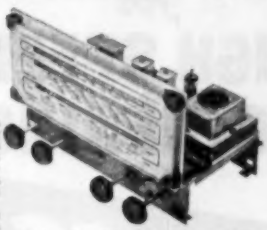
Two input jacks are provided, the first has a sensitivity of 1-micro volt for crystal microphone, etc. The other for use with radio inputs and pickups has a sensitivity of 250 mv. The power output is 4 watts internally matched for 3 ohm loudspeaker. A magic eye is used to indicate depth of recording—the circuit of this, however, is disconnected during replay. The frequency response of the amplifier is extremely wide, so ensuring that the best possible reproduction is obtained with modern tapes and heads. Using the Truvox heads the response is virtually level from 50 to 10,000 c.p.s. In addition to the two independent volume controls there is also a tone control and a master switch for record and replay. The amplifier is suitable for A.C. mains, voltages from 110 to 250.
Price £15. Carriage and insurance 7/6.

MINIATURE PORTABLE T.V.

THE ELPREQ MINIATURE TELEVISOR Uses standard conventional circuitry employing a total of 13 valves and 2 crystal diodes. The Cathode-ray tube used is a 2½in. Service type VCR-139A, which has a standard equivalent and will therefore always be obtainable. The layout is extremely clean, straightforward and professional. The wiring, whilst naturally being a little more intricate due to miniaturisation, is nevertheless completely accessible. The total cost comes to £16-£17. Its size will be approximately 9½in. × 8in. × 6in. Full construction data, layouts, diagrams, templates, etc., running into some 50 sheets, is available, price 5/-, post free.

THE

CLEVELAND "ORGANTONE"



The Cleveland "ORGANTONE" is a 5-valve 3-wave band superhet covering long wave (1,020-1,875 metres), medium wave (187.5-545.5 metres) and short wave (16-50 metres). Built to a very stringent specification, it attains a high level of performance both with regard to sensitivity and fidelity.

Osram all-glass miniature valves are employed throughout and low loss iron cored coils in both aerial and oscillator sections together with permeability tuned I.F.'s account for an excellent signal to noise ratio. Full A.V.C. is applied to both frequency changer and I.F. stages, and particular care has been taken to ensure freedom from frequency drift.

The output stage utilises variable negative feedback for tone control, and, but for standard pentode correction, no cut in the ordinary sense is applied. A gram. position is provided on the wave change switch and reproduction of records is particularly good.

An amply proportioned power transformer with a primary tapped for 110-250 volts gives complete isolation from the mains.

Chassis size is 12in. × 7in. × 7in.—Scale size is 10¼in. × 4¼in.

This receiver has been tested in particularly difficult areas and its stability and noise rejection have produced exceptional results. It is an instrument which could fairly be described as a custom-built chassis.

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A circuit diagram and photograph available price 2/- post free.

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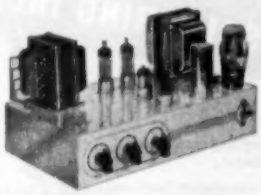

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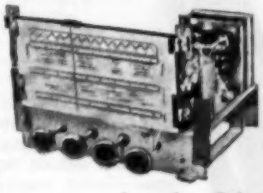

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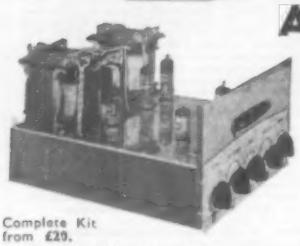

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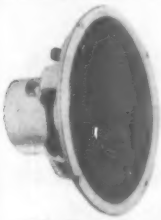

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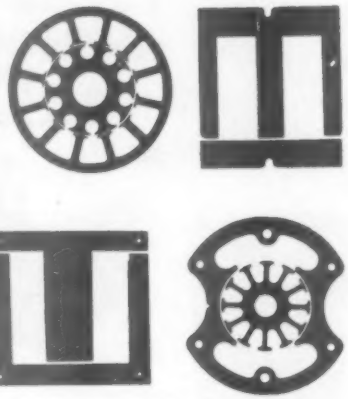

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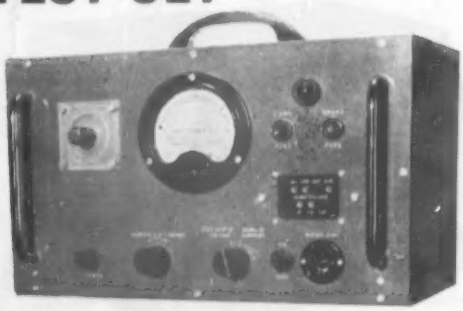

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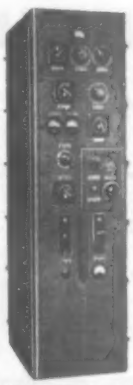

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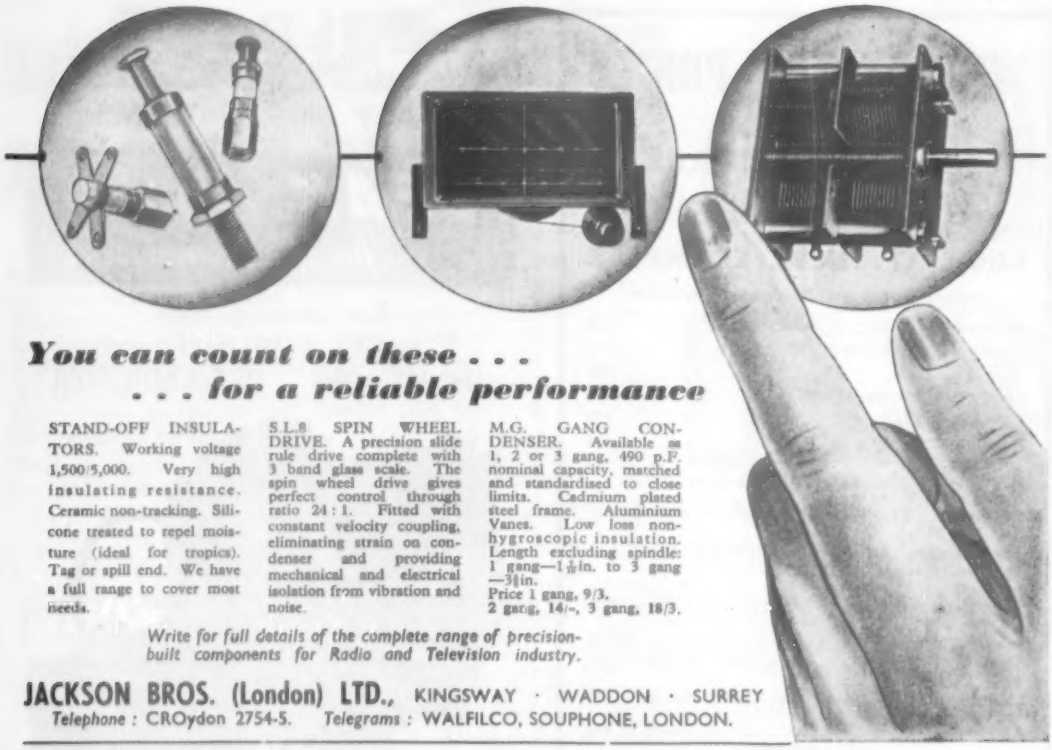

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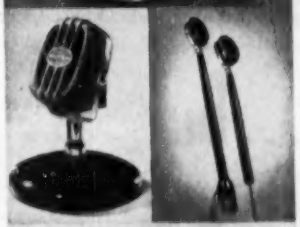

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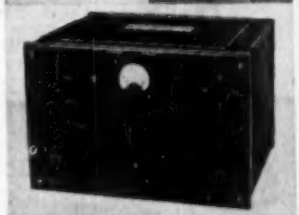

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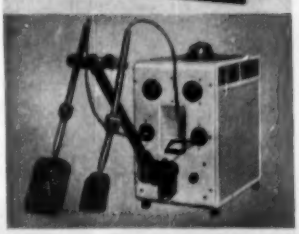

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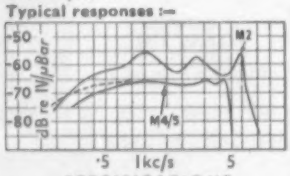

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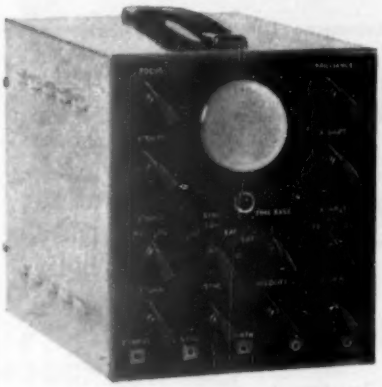

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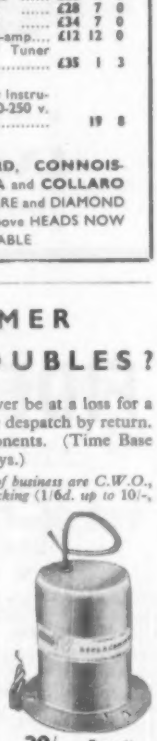

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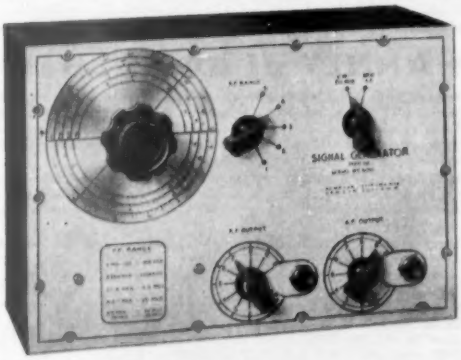

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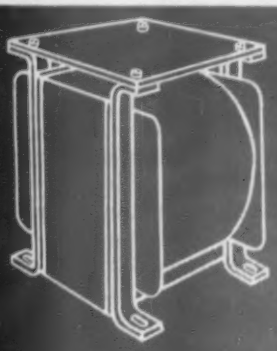

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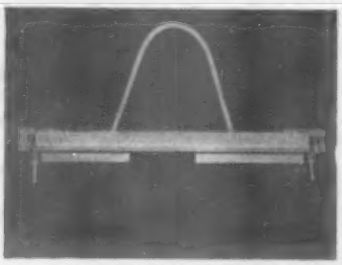

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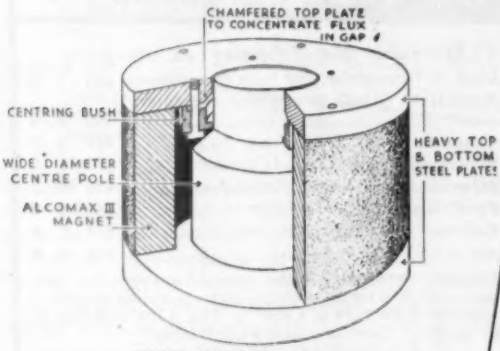
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In the last few years I have tried several speakers, including a well-known English make, and although the results were good, I was not satisfied. Several months ago I invested in a Williamson amplifier, and I realise now what a wise choice the new speaker was; truly a worthy companion to a good amplifier.

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In conclusion, I must also congratulate Mr. Briggs on his book SOUND REPRODUCTION, which I have found most instructive. As a result I designed a 9 cubic feet vented enclosure for your speaker. I think it allows the best advantage to be made of the excellent bass response.

You may publish any part of this letter if you wish.

I remain,

Yours faithfully,

JOHN ROGERS

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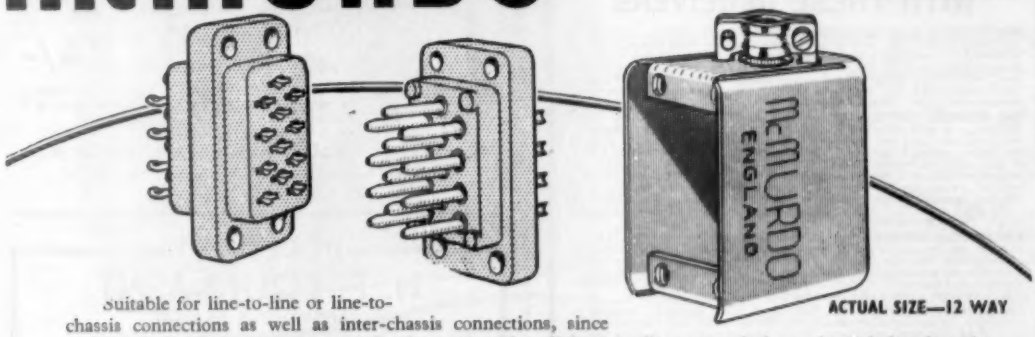

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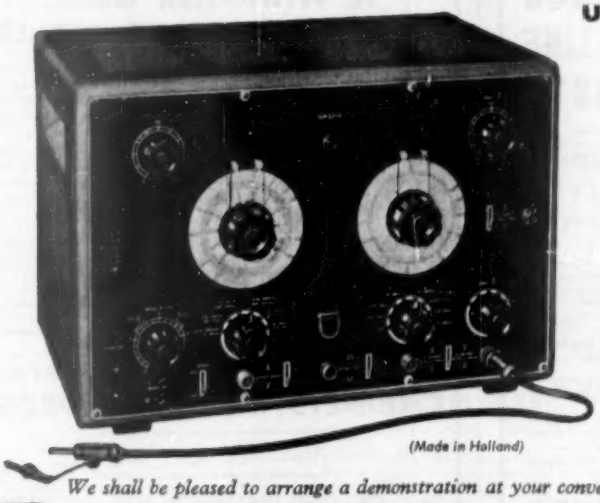

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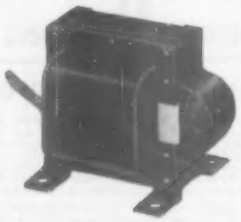

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PERFECT FRINGE AREA RECEPTION – BETTER RECEPTION AT HALF COMMERCIAL COST

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- A lifelike, almost stereoscopic, picture quality made possible by the following factors:
  a. Excellent band width of I.F. circuits.
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  c. C.R.T. Grid modulated from low impedance source.
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  The picture brilliance is also much above the average and enables comfortable viewing with normal room lighting or daylight.
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- Negative feedback is used in the audio frequency circuits which provide 2/3 watts of High Quality Sound.
- Entire receiver built on two chassis units each measuring 14½in. × 6½in. × 3½in.
- Rigid C.R.T. mounting enables entire receiver to be safely handled with tube in position.

●All pre-set-controls are mounted on side of chassis, enabling all adjustments to be carried out whilst facing the C.R. Tube.

This complete TELE-VISOR, including all Valves, can be built for only (*Plus cost of C.R.T.*) **£28/16/4**

As no hire purchase terms are available the receiver can be bought in five separate stages (practical diagrams and circuits are provided for each stage) thus enabling hire purchase interest rates to be avoided. The complete set of ASSEMBLY INSTRUCTIONS is available, price 5/-. The instructions include really detailed PRACTICAL LAYOUTS, WIRING DATA AND COMPONENT PRICE LIST. ALL COMPONENTS ARE AVAILABLE FOR INDIVIDUAL PURCHASE.

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This amplifier will give 3 watts output for the small input voltage of only 75 millivolts, and is therefore suitable for use with any type of pick-up from the crystal type to the miniature H/F Magnetic type.

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Price of fully assembled chassis ready for use, £5/5/- (plus cost of speaker).

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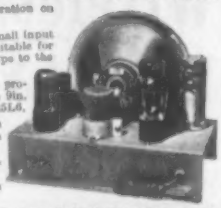

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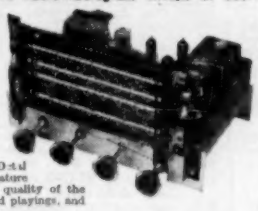


Incorporating the new B.V.A. Miniature Valve Line-up. This receiver is designed to the very latest specification and provision is made to incorporate either the standard Octal Valve Line-up or the new B.V.A. range of miniature valves. Great attention has been paid to the quality of the reproduction of both Radio reception and Record playings, and excellent clarity of speech and music is obtained.

A few brief details.

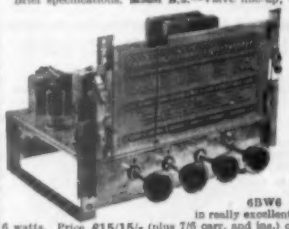
- Covers 3 wavebands 18-50 metres, 190-550, and 800-2,000 metres.
- Employs 6 valves having PUSH-PULL for 5-6 watts output.
- Incorporates delayed A.V.C. on all wavebands and pre-selective feedback.
- A 4 position Tone Control operates on both Radio and Gram.
- Has independent mains supply socket for a Record Player.
- Size of Assembled Chassis 12in. × 8in. × 8in. Dial aperture 8¼in. × 4¼in.
- For operation on A.C. mains 200-250 volts 50 cycles.

THE INSTRUCTION and ASSEMBLY MANUAL is available for 2/-. It contains very detailed practical drawings and circuit diagrams and a complete Component Price List.

THREE COMPLETELY ASSEMBLED ALL-WAVE SUPERHET CHASSIS

- Model B.3. A 5-valve 3-waveband Receiver.
- Model B.3.P.P. A 6-valve 3-waveband Receiver with PUSH-PULL OUTPUT.
- Model B.3.P.P./R.F. A 7-valve 3-waveband Receiver incorporating an R.F. stage with PUSH-PULL OUTPUT.

The three Receivers are for operation on A.C. mains 100/110 volts and 200/250 volts, and employ the very latest miniature valves. They were designed to the most modern specification great attention having been given to the quality of reproduction which gives excellent clarity of speech and music on both gram. and radio, making them the ideal replacement chassis for that "old Radiogram," etc.



Brief specifications: **Model B.3.**—Valve line-up, 6BE6, 6BA6, 6AT6, 6BW6, 6X4—waveband coverage short 16-50, medium 187-550, long 900-2,000 metres. Controls: (1) volume with on/off; (2) tuning (flywheel type); (3) wavechange and gram; (4) Tone Control (operative on gram. and radio). Negative feedback is employed over the entire audio stages. Chassis size: 11 × 7½ × 8¼in. high. Dial size 8¼ × 4¼in. Price complete and READY FOR USE, excluding speaker **£12/12/-** (carr. and ins. 7/6 extra).

H.P. Terms: **£3/4/-** deposit, 12 months at **17/6**.

Model B.3.P.P. This model is the B.3 Receiver but incorporates two 6BW6 VALVES in PUSH-PULL, resulting in really excellent quality reproduction up to approximately 6 watts. Price **£15/15/-** (plus 7/6 carr. and ins.) or **£3/19/-** deposit, 12 months at **£1/8/2.**

Model B.3. P.P./R.F. This model is similar in appearance and has same waveband coverage, as the Model B.3, but in addition it incorporates an R.F. STAGE together with PUSH-PULL OUTPUT, employing a total of 7 valves with two type 6BW6 in Push-Pull. This makes for a really sensitive receiver with genuine quality reproduction. Price **£18/18/-** (plus 7/6 carr. and ins.) or **£4/13/-** deposit, 12 months at **£1/6/9.**

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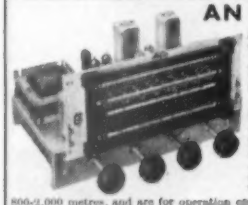

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For only £12/19/6 (Carr. and Ins. 7/6 extra.).

H.P. Terms **£3/4/6** Dep. 12 months at 18/4.

These receivers Model AW3-7 are made by a well-known set manufacturer and incorporate the latest Osram Valve Line-up of X79—W77—DH77—H77—U78 and two N78's in Push-Pull for approx. 7 watts output.

They cover 3 wavebands 18-50 metres, 190-550 and 800-2,000 metres, and are for operation on A.C. mains 200-250 volts. A Gram position is on the Wavechange Switch.

They make an excellent replacement Radiogram Chassis having a P.U. connection on the chassis. Extension speaker connection is also provided. Overall size of chassis: 12in. long × 7¾in. × 6¼in. high, dial aperture 8¼in. × 4¼in. (Dial Escutcheon available for **4/9**).

THESE RECEIVERS ARE BRAND NEW AND FULLY GUARANTEED.

109 and 115 FLEET ST., London, E.C.4. 'Phone: CENtral 5812/3/4

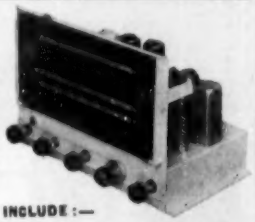
This 3 SPEED AUTOCHANGER is by a Famous Manufacturer and is offered for

£11/10/0 (Plus 7/6 Carr. & Ins.) **Normal Price £16/10/0**

Hire Purchase Terms £2/17/6 Dep. and 12 months at 16/4.

- These units will autochange on all three speeds, 7in., 10in. and 12in.
- They play MIXED 7in., 10in. and 12in. records.
- They have separate sapphires for L.P. and 78 r.p.m., which are moved into position by a simple switch.
- Minimum baseboard size required 14in. × 12½in., with height above 5½in. and height below baseboard 2½in. A bulk purchase enables us to offer these BRAND NEW UNITS at this exceptional price.

THE NEW ARMSTRONG F.C. 48



6-valve 4-waveband Receiver Chassis
A high quality replacement Radio or Radiogram Chassis having provision for an F.M. Feeder Unit.

PRICE, ASSEMBLED and READY FOR USE £23/18/0

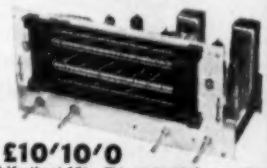
(Plus 7/6 Carr. and Ins.)

H.P. Terms **£5/18/0** Deposit and 12 months at £1/13/9.

OUTSTANDING FEATURES INCLUDE:—

- 6 Valves including 2 double Triodes.
- 6 Watts output from push-pull tetrodes. Heavy negative feedback is used resulting in negligible distortion and high damping factor.
- Provision for using F.M. adaptor to receive the present high quality transmissions from Wrotham and the new B.B.C. V.H.F. stations.
- An accessible socket at rear provides the power supply for this unit.
- Independent controls give BASS and TREBLE lift and cut with unique Thermaucier visual indicator.
- Gram position on wavechange switch.
- 4 Wavebands Coverage 16-51, 50-120, 190-550, 1,000-2,000 metres.
- Large four-colour illuminated dial.

A Replacement RADIO-RADIOGRAM CHASSIS



- **MODEL AW3-4.** A 5-Valve Superhet Receiver covering the standard 3 wavebands, 16-50 190-550, 900-2,000 metres. PRICE COMPLETELY ASSEMBLED AND READY FOR USE (plus 7/6 carr. and ins.).

£10/10/0

H.P. Terms **£2/19/6** Deposit and 12 Months at 15/-. This receiver is for operation on A.C. Mains 200-250 volts. It contains the latest MULLARD VALVE LINE-UP, being ECH42 (Freq. Ch.), EF41 (I.F.), EBC41 (Det. 1st Audio), EL41 (Output) and EZ41 (Rect.). The four controls being (1) Tuning. (2) Wavechange and Gram. Switch. (3) TONE. (4) VOLUME-OFF. It provides really good reproduction on both Gram. and Radio and gives an exceptionally good range of station selection. Overall size 13½in. × 7in. high × 6in. deep. Dial aperture 10in. × 4¼in.

THE COLLARO MODEL 3/514 3-Speed Non-Auto Change Unit £7/19/6

Normal Price £12/17/6 (Plus 6/- Carr. and Insur.)

- Complete with High Fidelity Crystal "TURNOVER" Head which incorporates a separate stylus for L.P. and standard Records.
- Will play 7 inch, 10 inch and 12 inch Records.
- Brand New and Complete with mounting instructions.

SPECIAL REDUCTIONS FOR COMPLETE EQUIPMENT

SUMMARY—Select a RECEIVER CHASSIS and we will supply it TOGETHER WITH THE ABOVE 3-SPEED CHANGER AND AN 8-inch or 10-inch P.M. SPEAKER as follows:—

THE £11/10/0 AUTOCHANGER WITH A SPEAKER AND:—

	Cash Price	Deposit	Monthly
(a) With Model B3 chassis	£24 15 0	£6 4 0	12 of £1 14 10
(b) " " B3PP	£28 0 0	£7 0 0	12 of £1 19 5
(c) " " B3PP/RF	£31 2 0	£7 15 0	12 of £2 3 9
(d) " " Armstrong F.C.48	£36 4 0	£9 1 0	12 of £2 10 11
(e) " " AW3-5	£29 15 0	£5 10 0	12 of £1 12 4
(f) " " AW3-7	£25 5 0	£6 7 0	12 of £1 15 5

An additional charge of 10/- is made in each case to cover Carriage and Insurance.

"Hi-Fi" EQUIPMENT and KITS
TO SUIT ANY BUDGET

TWO COMPLETE "Hi-Fi" AMPLIFIER KITS

A HIGH QUALITY 8-10 WATT AMPLIFIER
THE IDEAL AMPLIFIER FOR GENERAL HOME USE AND FOR SMALL HALLS, ETC.

Price of COMPLETE KIT including Valves and Drilled Chassis, etc. **£7/10/0** (Plus 2/6 Carr. & Ins.).

We will supply it Completely Built for **£9/10/0** (Plus 2/- Carr. & Ins.).

Designed for high quality reproduction up to an output level of 10 watts, having 6V6s in Push-Pull and incorporating negative feedback. It is suitable for use with all types of Pick-ups and most types of microphones and the output transformer provides for use of 2 and 15 ohms speakers.

BRIEF FEATURES

- Valve line up 6J5, 6SN7, 5Z4, with 6V6s in push pull.
- The undistorted output level of up to 10 watts is produced from an input of .25 volts.
- First class reproduction of Radio (where a Tuning Unit is used) and Record Playing.
- Separate Bass Boost and Treble Controls provide an excellent range of frequency control.
- Very satisfactory results are obtained with an average type of high impedance Moving Coil or Crystal Microphone, a clear speech level of approx. 5 watts output being obtained.
- Power supplies (HT and LT) are available for a Tuning Unit.
- For operation on A.C. Mains 200-250 volts 50 cycles.

THE ASSEMBLY MANUAL is available for 1/- and includes detailed layouts and component Price List.

A 12 Watt "HIGH FIDELITY" Push-Pull AMPLIFIER

Comprising a Main Amplifier Chassis and a Remote Control Pre-Amplifier-Tone Control Unit. The remote control unit measures only 7in. × 4in. × 2in. and contains four controls, being: Bass-Treble-Volume and a Radio, Gram, Microphone Switch control. It incorporates its own feedback circuit on the Bass Channel. Loop negative feedback is employed on the Main Amplifier which has a valve line up of 6J5-6N7-5U4 with two PX25's in push-pull and 6J5 and 6SN7 are used in the remote control unit.

THE COMPLETE KIT IS AVAILABLE FOR **£14/0/0** (Carr. & Ins. 3/- extra).

THE COMPLETE UNIT ASSEMBLED AND READY FOR USE **£17/0/0** (Carr. & Ins. 5/- extra).

H.P. Terms **£4/5**/- Deposit, 13 Months at **£1/3/11**.

The measured frequency range of the amplifier with this unit shows an excellent response from 14,000 cycles down to 20 cycles, the bass and treble controls allowing independent control of gain at both ends of the frequency range from zero to a gain of 50. It can be seen, therefore, that ample correction is provided to suit any type of pick-up with any type of recording. Input voltage for maximum output is 70 mV. 6.3 volts at 2 amps. and 30 mA. H.T. is provided for tuning unit, etc. **This Amplifier compares well with the Williamson and similar designs at a fraction of their cost. The complete set of assembly instructions is available for 2/-.**

The NEW "LEAK" TL/10 AMPLIFIER and "POINT ONE" PRE-AMPLIFIER

This Amplifier has a maximum output of 10 watts and maintains in every respect the world renowned LEAK reputation for precision engineering; fine appearance and fastidious wiring. The Pre-Amplifier will operate from any make or type of pick-up. A continuously variable input attenuator at the rear of the Pre-amp. permits the instantaneous use of crystal, moving iron and moving coil pick-ups. H.T. and L.T. supplies are available for a Radio Tuning Unit. An input attenuator is fitted. S.A.E. for descriptive leaflet.

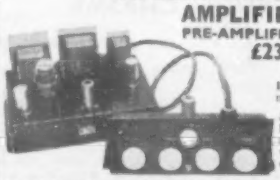
PRICES :

(a) The **COMPLETE AMPLIFIER WITH PRE-AMPLIFIER**, **£26/7/0**, or **£7/2/0** Deposit and 12 months at **£2**.

(b) The **TL/10 MAIN AMPLIFIER ONLY : £17/17/0**, or **£4/7/0** Deposit and 12 months at **£1/5/4**.

(c) The "**POINT ONE**" **PRE-AMPLIFIER ONLY : £10/10/0**, or **£2/12/6** Deposit and 12 months at **15/-**.

ROGERS—RD BABY de Luxe MK II AMPLIFIER with RD JUNIOR Mk II PRE-AMPLIFIER COMPLETE FOR **£23/0/0** (Plus 7/6 Carr. & Ins.)



H.P. Terms: **£5/15**/- Deposit and 12 months at **£1/12/4**.

A medium-priced 8-10 watt push-pull de Luxe Amplifier of very attractive appearance and embodying a high standard of workmanship. Complete performance data is available. Please send S.A.E.

THE FAMOUS WILLIAMSON AMPLIFIERS BY GOODSELL

These Amplifiers hardly need enlarging upon, it being sufficient to say that they have now become the accepted standard for quality reproduction by which all others are judged

Two Models are available:

MODEL G.W.18. Built completely to specification and giving 15 watts output. Price **£33/15/-** (plus 7/6 carriage and insurance). H.P. Terms. Deposit **£8/9/-** and 12 months at **£2/7/5**.

MODEL G.W.12. Uses slightly lower H.T. voltage to produce 10-12 watts output but otherwise is built completely to specification. Price **£27/10/-** (plus 7/6 carriage and insurance). H.P. Terms. Deposit **£6/17/6** and 12 months at **£1/18/8**.

A BULK PURCHASE ENABLES THIS SPECIAL PRICE REDUCTION OF THE FAMOUS SHAFTESBURY PORTABLE AMPLIFIER

Suitable for home use and small Halls. Has matched inputs for both Record Players and Microphone. Also provides for the "mixing" and "fading" of both Gram. and speech as requested.

COMPRISING

(a) A 4-Valve High Gain Amplifier for use on A.C. or D.C. mains 200-250 volts with 5 watts output. Incorporating independent Volume Controls for Mike and Gram., either of which can be faded at will, a variable Tone Control and independent input sockets for Mike and Gram.

(b) A Transverse Carbon microphone which obtains its polarizing current from the amplifier—no batteries are necessary.

(c) An 8in. Goodmans P.M. Speaker with the "Ticonal" magnet for first-class reproduction.

THE COMPLETE EQUIPMENT is all contained in the **PORTABLE CARRYING CASE** **£18'0'0**

Having been reduced from £30/9/-. HIRE PURCHASE TERMS. DEPOSIT **£4/10/0** and 12 monthly payments of **£1/5/4**. ● Light in weight ● Easy to CARRY ● GENUINELY PORTABLE. An illustrated leaflet containing free data is available on receipt of S.A.E.

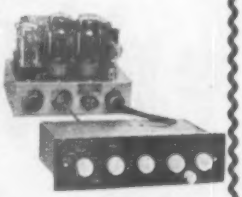
THE MODEL P.F.A. TONE CONTROL UNIT.

This Control Unit has established a reputation for its excellent quality of reproduction, and ability to give adequate gain for any type of pick-up.

Price **£20/-/-** (plus 7/6 carriage and insurance). H.P. Terms. Deposit **£5/-/-** and 12 months at **£1/8/2**.

WE HAVE THEM IN STOCK AND WILL BE PLEASED TO DEMONSTRATE

or send S.A.E. for illustrated and descriptive leaflet.



THE GOODSELL "ULTRA LINEAR" M.A.S. AMPLIFIER.

A "High Fidelity" Amplifier using a Triode connected push-pull output stage providing 10-12 watts output.

Price **£14/17/6** (plus 7/6 carriage and insurance).

H.P. Terms. Deposit **£3/12/6** and 12 months of **£1/1/1**.

THE TONE CONTROL—PREAMP. UNIT.

Recommended for this Amplifier is the model UL/P/T.C. Its main features are adequate equalising for gramophone reproduction, separate control of bass and treble and low pass filter. Feedback is used over each of four stages.

Price **£12/12/-** (plus 6/- carriage and insurance).

H.P. Terms. Deposit **£3/4/0** and 12 months at **17/8**.

When submitting orders, please include postage and packing.

STERN RADIO LTD.

CONSTRUCTORS say "IT'S STILL THE BEST MAINS or BATTERY PORTABLE SET"

A Midget 4-valve Superhet Portable covering medium and long wavebands. Designed to operate on A.C. mains 200/240 volts or by an "Alldry" battery. The set is designed so that the main section can be supplied as a separate unit, and can be added at any time. The set supplied as an "Alldry" battery Superhet can be accommodated in the attache case illustrated (size 9¼in. × 4¼in. × 7in.). This is attractively finished in linard, maroon, dark green or blue rexine. As a combined Mains/Battery Superhet Portable a polished cabinet is available to accommodate both Mains Unit and Batteries. Circuit incorporates delayed A.V.C. and pre-selective Audio Feedback. The Set is complete in every detail and includes ready-wound frame aerials, fully aligned I.F. transf. and drilled chassis etc. Overall size of assembled chassis 9in. × 6in. × 2¼in. This receiver as illustrated, can be completely built for **£8/16/3** (plus Mains Unit if required). Send 1/3 for the fully descriptive Assembly Book which includes Practical Layouts and complete Price list of Components. Attache case available separately, **37/6**.

BATTERY PORTABLE

THE "MINI TWO-THREE"

An "Alldry" Battery Portable of midget size, 6¼in. × 4¼in. × 3¼in. designed to cover medium waveband 190-559 metres, with use of short trailer aerial.

The simple design of this Receiver is so arranged that either a 2-valve set or a 2-valve (afterwards easily converted to the 3-valve) can be made.

Consists of a T.R.F. circuit using a regenerative detector with H.F. stage and a high gain output pentode. Valve line up 1T4—1T4—DL94.

The 2-valve set can be completely built for **£4/3/6** (less case) and the 3-valve for **£5/3/-** (less case). Each price includes valves, speaker and drilled chassis.

Send 2/- for the assembly instructions: they include simple and complete practical component layouts and diagrams which enable the most inexperienced constructor to successfully build either set. All components are available for separate sale, a price list being supplied with assembly instructions.

"PERSONAL SET" BATTERY ELIMINATOR

A complete Kit of parts to build a Midget "Alldry" Battery Eliminator, giving approx. 69 volts and 1.4 volts. This eliminator is for use on A.C. mains and is suitable for any 4-valve Superhet Receiver requiring H.T. and L.T. voltage as above, or approx. to 69 volts.

The Kit is quite easily and quickly assembled and is housed in a light-aluminium case size 4½in. × 1¾in. × 3¼in. Price of complete Kit with easy-to-follow assembly instructions, **47/6**.

In addition we can offer a similar COMPLETE KIT to provide approx. 90 volts and 1.4 volts. Size of assembled unit 7in. × 2¼in. × 1¼in. Price **47/6**.

A COMPLETE "CAR RADIO" FOR THE HOME CONSTRUCTOR

11¼in. × 4¼in. × 3¼in.

A design of a complete 5-VALVE SUPERHET RECEIVER employing an R.F. Stage, and incorporating a separate VIBRATOR PACK size 4½ × 2½ × 6¼in. for use on 5 or 12 volt D.C. supplies.

We can supply all components to build this complete Receiver and Vibrator Pack including a Metal Case, Valves, Drilled Chassis and 5in. P.M. Speaker for **£13/9/6**. (Carr. and Ins. 5/6 extra.) Or the Receiver Components for **£9/19/6** and the Vibrator Components for **£3/10/-**.

This is NOT an EX-GOVT. Receiver, it is a new design employing new Components. Send **2/8** for the complete set of ASSEMBLY INSTRUCTIONS, CIRCUITS and PRACTICAL LAYOUTS, including a complete individual Component Price List.

!!!CONSTRUCTORS!!!

A NEW SUPERHET TRANSPORTABLE

THE "SUPER THREE"

Designed for local station reception without the use of an external aerial. This design provides for a 3 valve (plus Metal Rectifier) Superhet Receiver incorporating a Frame Aerial for "room to room" use, provision is also made for a short external aerial, if required, for the reception of Continental Stations.

Briefly the features are as follows:—

- For use on A.C. Mains 200-250 volts.
- This set includes a Mains Transformer and Chassis is NOT live to mains (as many other sets of this type are) and consequently the Receiver can safely be used in the Kitchen, etc.
- Valve line up 6K8—6J7—KT61, plus Metal Rectifier.
- The I.F. Transformer is supplied "pre-aligned" and thereby ensures extreme simplicity of Tuning—in fact, more simple than most T.R.F. Receivers.
- Compact and easy to build simple "point to point" practical diagrams are supplied with a completely drilled chassis.

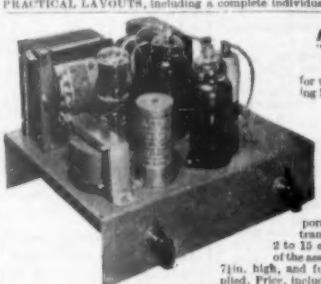
The complete Receiver Chassis can be built to cover the Medium Waveband only for **£6 . 6 . 6**

Or to cover both Long and Medium Waves for **£6 . 16 . 3**

If the Receiver is first built to cover the Medium Waveband, Long Waves can be added at any time, separate diagrams are provided for this purpose.

The attractive Polished Wood Cabinet 11¼ inches wide, 8¾ inches high and 6 inches deep illustrated above is **£1 . 1 . 0**

The CONSTRUCTOR'S MANUAL is available for **1/-**, this shows the component prices which are all available for separate purchase.



A 4-VALVE QUALITY "PUSH-PULL" 6-8 watt AMPLIFIER

for use on A.C. mains. Incorporating Negative Feedback, Filter Input Circuit and employing 6V6s in Push-Pull. A simple arrangement is provided to enable either a magnetic, crystal or lightweight pick-up to be used, and is suitable for use with Standard or long-playing records. A tone control is incorporated, and the 10-watt output transformer is designed to match 2 to 15 ohm speakers. The overall size of the assembled chassis is 10in. × 8in. × 7¼in. high, and full practical diagrams are supplied. Price, including drilled chassis and valves, of complete kit, **£6/17/6**. Price of assembled chassis, supplied ready for use, **£8/12/6**. Plus 5/- Carr. & Ins. Full descriptive leaflets are available separately for 1/-.

DUAL-CHANNEL PRE-AMPLIFIER and TONE CONTROL UNIT

This comprehensive PRE-AMPLIFIER and TONE CONTROL UNIT provides a full control of bass and treble in conjunction with a main Volume/Mixer Control.

It can be used with any amplifier and with any pick-up, the range of frequency control provided by the unit affording ample compensation for all types of pick-up and all natures of recordings, i.e., English, American and long-playing, without recourse to pick-up correction. The extreme flexibility of the bass and treble control is such that the level of bass and treble can be set to suit any conditions irrespective of the volume output of the amplifier. Response characteristics are given in 12-watt amplifier o/put. The unit measures only 7in. × 4in. × 2in., including self-contained power supply and can be accommodated either on or away from the main amplifier, i.e., on the front panel of a cabinet or any other position. Price including drilled chassis, valves (6SN7 and 6J5), **£3/16/6**. Complete assembly data are available separately for 1/-. Completely assembled and ready for use, **£5/5/-**.

"MINI-TWIN" 1-VALVE BATTERY SET

A design of a simple 1-valve 2-stage Battery Receiver giving excellent results on medium and long wavebands and having exceptionally low battery consumption. Drilled chassis and practical diagrams make it the ideal set for the beginner to build.

The complete chassis, including valves, can be built for **37/6**, plus 5/11 P/Tax, the attractive plastic case is **9/6** and suitable headphones, **14/9**.

The complete assembly instructions, layouts and a component price list are available for **1/6**.

This Receiver also performs excellently, without modification, as a tuning unit, and, in addition, with simple modifications for which a complete diagram is provided, makes a first-class pre-amplifier for pick up or microphone.

AN AMAZING OFFER!

A COMPLETELY ASSEMBLED

4 VALVE T.R.F. CHASSIS

Including a 5in. P.M. SPEAKER and VALVES

FOR ONLY **£6/9/6**

(Plus 7/6 carr. and ins.)

This receiver is of the very latest design and is for use on A.C. or D.C. Mains. It covers both Long and Medium Wavebands, and includes the modern BVA miniature valves The line up being 1/2 BA6—1BA7/6—1BA6—35W4. It incorporates Permeability Tuned Coils, thus ensuring excellent selectivity and sensitivity. The overall size of the complete chassis including speaker is 10½in. × 4½in. × 6½in. An attractive Bakelite Ivory-finished Cabinet size 11½in. × 5½in. × 6½in. is available for **16/6** (plus 2/6 carriage and insurance).

109 and 115 FLEET ST.

LONDON, E.C.4 Phone: CENTRAL 5812-3-4

MIDGET RADIO CABINETS

This well-known cabinet of which thousands have been sold is ideal for every constructor. Complete with chassis, dial, backplate, cord drive, pointer and dial drum.
Price 27/6 each.

SHOKES

20H, 250Ω, 60 mA. Clamp construction ..... 6/- ea.
10H, 200Ω, 80 mA. Clamp Construction ..... 9/3 ea.
5H, 250 mA., 200Ω. Fully shrouded ..... 18/3 ea.

TRANSFORMERS FOR BATTERY CHARGERS

250 v. Input Tapped 6-12 v. 1 amp. ..... 13/6 ea.
230 v. Input Tapped 6-12 v. 3 amp. ..... 18/- ea.
(Both with tap on Primary for 2.5 v. Pilot light)

LOUDSPEAKER CABINETS

This attractive walnut finished cabinet is available for 6½in. or 8in. speaker units. Metal speaker fret, complete with back and rubber feet.

6½in. type:
Measures 8½in. × 8½in. × 4½in. at base. Price 15/6 each.

8in. type:
Measures 10½in. × 10½in × 8in. at base. Price 19/6 each.

CARRYING CASE

Suitable for use as a projector or recording case, size 15in. × 9½in. × 12in. Internal dimensions: 14in. long, 11½in. deep, 8½in. front H.T. 8½in. rear H.T. With a black rexine finish. Weight 8½lb. .. 13/6 ea.
Post and packing 2/6.

"CLEM" Travelling Iron with Asbestos Base.

Size 4in. × 2in. × 2½in., including handle, complete with lead and switch to enable it to be used on any voltage between 110 and 250 v. A.B.C. adaptor is fitted on the lead. (Colour as available: Blue, Green, etc.) ..... 17/6 ea.

RENTERGEL RECTIFIERS

RM1, 3/9 ea.; RM2, 4/2 ea.; RM3, 5/- ea.; RM4, 16/- ea.

METAL RECTIFIERS

12 v. ½ amp., 1/6 ea.; 12 v. 1 amp. 4/6 ea.; 2 v. 1 amp., 2/- ea.; 250 v. 45 mA., 6/3 ea.; 200 v. 75 mA., 7/6 ea.; 300 v. 60 mA. 7/6 ea.

FULL WAVE TYPES

12 v. 1 amp. 4/9 ea.; 12 v. 2 amp., 8/- ea.; 12 v. 3 amp. 13/- ea.; 12 v. 6 amp. 18/- ea.

WE INVITE YOU TO BUILD THIS PORTABLE FOR ONLY 6½gns.

Full details, circuit diagram, point to point wiring instructions, and complete list of components. Available 2/- ea. Case can be supplied separately. Available in the following attractive colours: ● Lizard Grey; ● Blue; ● Maroon; ● Brown. Dial, 1/3 each. Chassis, 8/-.

ALPHA SPECIAL PURPOSE VALVES

2X2	5/-	807	7/6	956	3/6	VR65	3/9
1A5GT ...	6/6	9001	5/6	CV173	10/-	VR65A ...	3/4
1LD5 ...	6/9	9002	5/6	CV286 ...	7/6	VR66	3/9
5Z3	8/6	9003	5/6	E1148	2/-	VR91	4/-
6B4	6/-	9004	5/6	VR53	4/6	VR91(SYL)	8/-
6G6G	6/6	9006	6/-	VR54	2/-	VR92	2/-
6ST7	7/6	954	2/-	VR55	7/6	VR105/30	9/-
VR119 ...	4/-	VR136 ...	7/-	VR56	6/-	VR116 ...	4/-
VT52	8/-	TT11	6/-	VR137	6/3	VR150/30	9/-
VU111.....	3/6	VU120A ...	3/-	VU39	8/6	VU64 ...	8/6
77	8/-	955	4/9	VR40	8/-	Full List Available.	

ION TRAPS

Type IT6 for Tubes with 35 mm. neck diameter ..... 2/6 ea.

HEADPHONES—MICROPHONES, Etc.

EX-GOVERNMENT HEADPHONES BY S. G. BROWN, etc.

CLR Low resistance type 120 ohms ..... 7/6 pr.
CHR High resistance type 4,000 ohms ... 11/- pr.
DHR a super phone ..... 13/6 pr.
American phones by Trimm Mfg. Co. of Chicago, U.S.A., 1,200 ohms, each sargisce ..... 13/9 pr.
Headbands, wide type ..... 1/9 ea.
Throat microphones, American surplus. Complete with strap, lead and plug type T30B ..... 4/- set
"Regent" Hand Microphone. Crystal insert, nickel chrome plated head, complete with lead and jack plug, listed at 2 Gns. Our price ..... 21/- ea.
Throat Microphones, type Za.21095. 2 units per box ..... 1/8 per box
Acos Microphone insert type MIC/18 ..... 3/9 ea.

HEATER TRANSFORMERS

230 v. Input 2 volt .5 amp. 4/6
230 v. Input 2 volt 3.0 amp 7/9
230 v. Input 4 volt 1.5 amp. 5/-
230 v. Input 4 volt 3.0 amp. 10/-
230 v. Input 5 volt 2.0 amp. 10/-
230 v. Input 6.3 volt .5 amp. 5/-
230 v. Input 6.3 volt 1.5 amp. 6/-
230 v. Input 6.3 volt 3.0 amp. 9/-
230 v. Input 12 volt .75 amp. 5/-

OUTPUT TRANSFORMERS

Multi Ratio suitable for all ordinary receivers giving six single ratios ..... 6/6 ea.

CONTROL KNOBS in MODERN STYLING

Tastefully and clearly engraved in gold.
Size A. Diameter 1¼in. Depth ⅝in.
Size B. Diameter 1½in. Depth ⅝in.
These Mouldings are available in two colours: Walnut and Ivory.
They are suitable for use with ¼in. spindles and are simply and firmly held by means of a grub screw and locking nut.
Prices:
Type "A"—1/6 each.
Type "B"—1/2 each.
Plain Knobs can be supplied in either size or colour: Price 1/- each and 8d each respectively.
Inscriptions available:—
RADIO: "Volume," "VI/On-Off," "Wavechange," "Tuning," "S.M.L. Gram.," "Radio-Gram.," "Tone" "On-Off." TELEVISION: "Contrast," "Brilliance," "Brilliance/On-Off," "Focus," "Brightness." AMPLIFIER: "Treble," "Bass," (plus any of those shown above).
TAPE RECORDER:-" Record-Play."

THE COMPACT TELEVISION AERIAL BY ANTIFERENCE LTD.

Supplied complete with universal mounting and backplate in neutral brown finish. Overall length 3ft. 6in. Packed in carton 3ft. 4in. long. Complete with full instructions. Cat. No. CD4. Original price 50/-. Our price 12/6
Post etc. 2/6.

TINNED COPPER WIRE—All 4 oz. Reels.

16 S.W.G. 2/-
18 S.W.G. 2/2
20 S.W.G. 2/4
22 S.W.G. 2/6
24 S.W.G. 2/8
26 S.W.G. 2/10

ENAMELLED COPPER WIRE—All 4 oz. Reels.

S.W.G.	Price	S.W.G.	Price
16	1/11	30	2/1
18	2/1	32	3/3
20	2/3	34	3/5
22	2/5	36	3/7
24	2/7	38	3/11
26	2/9	40	4/2
28	2/11		

CHASSIS

Aluminium Undrilled with Reinforced Corners. Available in the following sizes.

6in. × 4in. × 2½in. ..... 4/6 ea.
8in. × 6in. × 2½in. ..... 6/3 ea.
10in. × 7in. × 2½in. ..... 7/3 ea.
12in. × 8in. × 2½in. ..... 8/6 ea.
14in. × 8in. × 2½in. ..... 9/6 ea.
16in. × 9in. × 2½in. ..... 12/- ea.
All are four sided—ideal for radio receivers—amplifiers—powerpacks etc.

SET OF VALVES. Ten VR91 (EF50) valves. Ex-Brand new units, 6/- each, 45/- set.

★ SPECIAL OFFER. CO-AXIAL CABLE. Best quality Grade "A" Cable: Solid 1/022 70 ohms. 7½d. yd. Stranded 7/0076. 8½d. yd. Air spaced 1/036. 1/- yd.

GRAMOPHONE MOTORS, etc. Collaro AC37 Gramophone motor suitable for 100/120 v. 200/250 v. A.C. variable speed complete with 10in. E.M.I. type turntable felt covered. Price 44/- each, plus 2/- post.

GOLDRING PICK-UP HEADS. Pick-up head type No. 112 (2,000 ohms), complete with lead. Price 17/6 each.

LOUDSPEAKER UNITS

FLESSEY 3in. Round type for personal portables 2 to 3 ohm 12/9
ELAC 4in. Square type 4/02, 2 to 3 ohms 13/9
GOODMAN'S 6½in. Round type 15/11
LECTRONA 6½in., With transformer 18/-
ELAC 6½in. Type 6/19, 2 to 3 ohm 15/6
TRUVOX 6½in. Wafer type, 1¼in. deep, 2 to 3 ohm 20/-
R. & A. 8in. Lightweight, 2 to 3 ohm 16/11
LECTRONA 8in. PM 2 to 3 ohms 16/6
THE LATEST ELAC 4in. × 7in. ELLIPTICAL UNIT 19/10 each.
ELAC 10in. Units 2 to 3 ohms 22/6
PLESSEY 10in. Lightweight .. 19/6
BAKERS "Selhurst" 12 in. unit 4gns.

PENCIL RECTIFIERS

K3/25, 5/8; K3/40, 7/6; K3/45, 8/2; K3/50, 8/8; K3/60, 9/5; K3/100, 14/5.

AMPLIFIER

THE "EKE" QUALITY 3 WATT AMPLIFIER

COMPARE THIS PRICE!

This is not a kit of parts but a well-built unit—read this specification.
★ 3 valves—6B8G, 6X5GT, 6V6GT.
★ Components 100%, only recently manufactured condensers used.
★ Strong chassis, sockets for all input and output leads.
★ Output 3Ω secondary.
★ Tone and volume controls.
★ Input for crystal or Hi-Fi magnetic pickups.
★ A.C. mains fully isolated.
★ Negative feedback.
Price 79/6 Packing & Post 2/6.

CONDENSERS

BR Range

BR.850 8 mfd. 500 v. ....ea. 2/9
BR.1650 16 mfd. ....ea. 3/3
BR.2050 20 mfd. 500 v. ....ea. 3/6
8 × 8 mfd. 500 v. ....ea. 4/-
BR.501 50 mfd. 12 v. ....ea. 1/9

Midget Metal Types

2 mfd. 350 v. 1/9
8 mfd. 350 v. 1/1
8 × 8 mfd. 350 v. 3/-
8 × 8 mfd. 450 v. 4/-
16 mfd. 350 v. 2/9
16 × 8 mfd. 450 v. 4/-
16 × 16 mfd. 450 v. 4/6
16 × 24 mfd. 350 v. 4/6
24 mfd. 350 v. 2/9
32 mfd. 350 v. 1/9
32 × 32 mfd. 350 v. 4/6
250 mfd. 12 v. 1/9

Wire ended Types

8 mfd. 450 v. Cardboard covered 1/11
30 mfd. 450 v. 3/9

Bias Condensers
Tag ended metal types

12 mfd. 50 v. 1/-
25 mfd. 25 v. 1/3
50 mfd. 12 v. 1/-
50 mfd. 50 v. 2/6
100 mfd. 12 v. 1/9
100 mfd. 25 v. 1/9

Wire ended Types. Cardboard covered

25 mfd. 25 v. 1/9
50 mfd. 12 v. 1/9
50 mfd. 50 v. 2/3

TECHNICAL PUBLICATIONS AND MANUALS

Radio Aerial Handbook .... ea. 2/6
Radio Hints Manual ..... ea. 2/6
Amateur Transmitter's Construction Manual ..... ea. 3/6
Radio Calculations Manual .. ea. 3/6
Sound Equipment Manual .. ea. 2/6
Radio Designs Manual .... ea. 2/6
Communications Receivers' Manual ..... ea. 2/6
Frequency Modulation Receivers' Manual ..... ea. 2/6

ONLY A FEW AVAILABLE

VCR 97 Cathode Ray Tubes ea. 29/6
Postage and packing 1/6.
Block Condenser 10 mfd. 450 v. ..... ea. 4/-
High Voltage Condenser, .1 mfd. 4 kV. Ceramic insulated terminals .... ea. 4/-

TERMS: Cash with order or C.O.D. Postage and Packing charges extra, as follows: Orders value 10/- add 9d.; 20/- add 1/-; 40/- add 1/6; £5 add 2/- unless otherwise stated. Minimum C.O.D. fee and postage 2/3.

MAIL ORDER ONLY

ALPHA RADIO SUPPLY CO.

5/6 VINCES CHAMBERS, VICTORIA SQUARE, LEEDS 1.

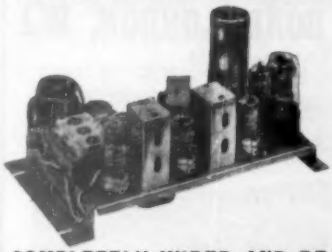
WHEN ORDERING PLEASE QUOTE "DEPT. W.W."

ANOTHER "SCOOP"

A COMPLETE 5 VALVE RADIO CHASSIS

BRAND NEW AND UNUSED

AC/DC Mains 200/250 volts



LASKY'S RADIO

For **69/6** LESS VALVES Postage 3/6. extra.

★ I.F. 465 Kc/s.
★ 4 Watts output.
★ A.V.C.
★ 3 Station Pre Set.
★ Frame Aerial.
★ Fully aligned.
★ Size of chassis only 10" × 5½" max. height 5½".

COMPLETELY WIRED AND READY FOR USE, WITH THE ADDITION OF A SPEAKER AND OUTPUT TRANSFORMER.

PRICE COMPLETE WITH VALVES £5 · 19 · 6

Two controls only : Volume and Station switch.

Valves used: 10C1 freq. changer, 10F9 or UF41 I.F. Amp., 10LD11 AVC and Det., 10P14 output, U404 or UY41 rect.

THE IDEAL SECOND SET

A Cabinet will be available shortly

YOU CAN FIT THIS UNIT INTO YOUR EXISTING T.V. RECEIVER FOR RADIO RECEPTION

Circuit diagram supplied. Available separately at 1/6. Post Free.

LASKY'S T.V. CONSTRUCTORS' PARCELS

No. 1 WIDE ANGLE PARCEL. Containing ferroxcube line E.H.T. transformer, ferroxcube scanning coils, frame output transformer, p.m. focus unit, frame blocking osc. transformer, 14-, 16- or 17-inch mask and glass, width and linearity controls. Also the following valves:—6U4gt, 6CD6, 6AL5, 2—6AM5 (N78), 3—12AU7. Full circuit.

LASKY'S PRICE COMPLETE **£8/15/11**

Carriage 3/6 extra.

No.2 The WIDE ANGLE PARCEL As No. 1 parcel. But less valves. LASKY'S PRICE **94/11**

Carriage 2/6 extra.

No. 3. All brand new components by Igranic. Comprises E.H.T. flyback line transformer, 7-10 Kv. with ferroxcube core and rectifier heater winding; scanning coils; frame output transformer; Eliac focus unit with vernier adjuster, U.25 E.H.T. rectifier, 12in. mask and glass. LASKY'S PRICE FOR THE COMPLETE PARCEL **79/6**

Carriage and packing 3/6 extra.

No. 4. Complete set of metal-work. Unassembled. Comprising main chassis, tube supports and valve-holders. (Less sound-vision chassis.) **PRICE 25/-.**

Carriage 3/6 extra.

PORTABLE RECORD PLAYERS Single speed auto changer, with amplifier. In case. A FEW LEFT AS PREVIOUS ADVT. **£10/19/6.** Carriage 10/6.

METAL RECTIFIERS
6 or 12 volt F.W. Bridge

2 amps	9/-	6 amps. ..	21/-
4 amps. ..	12/11	10 amps. ..	32/6

6 volts		12 volts	
½ amp	2/6	½ amp	3/11
1 amp	4/6	1 amp	6/6

SUPERHET COIL PACKS
With Circuit

No. 1. L.M.S.G. Size: 4½ × 5 × 2½in. With ¼in. spindle. **19/6.**

No. 2. M.S.S. Size: 4 × 4 × 3in. With ¼in. spindle. **16/-.**

Both for use with 465 Kc/s. I.F.

HIRE PURCHASE TERMS AVAILABLE ON CERTAIN ITEMS

Send for proposal form. Please give details of the equipment you require for quotation.

STILL ANOTHER SUPER BUY

Tape Recorder Heads By "Philosity"

High impedance, single hole fixing. Size 1in. diam., ¼in. high. Twin track.

Record/playback.	22/6.
Erase.	22/6.
Low impedance erase.	22/6.

FAR BELOW ACTUAL MANUFACTURING COST. LESS THAN HALF USUAL PRICE

Limited Quantity only.

12 VOLT-4 WATT MOBILE AMPLIFIERS
BRAND NEW AND UNUSED

KT.61 output. Complete with power unit, vibrator (type QFA/12), and all valves. Fitted with rubber covered heavy duty battery lead.

By famous manufacturer, in metal cabinet, grey crackle finish. Size: 10in. x 6½in. x 8in. Output impedance 3 ohms. With the addition of a loudspeaker, this is ready for operation. Finest quality components throughout.

Complete with carbon hand-microphone with screened lead. Can also be used as a power pack and output stage for a car radio.

LASKY'S PRICE COMPLETE **£7.19.6** OR LESS MICROPHONE **£6.19.6**

Carriage 5/- per unit extra.

CAR RADIO SPECIAL—PARTLY ASSEMBLED CAR RADIOS

Small size case, 12 × 4 × 6in. Will fit most cars. For either 6 or 12 volts, depending on vibrator. Chassis supplied with 5 octal valve holders, medium wave aerial and oscillator coils, output transformers, volume control, sundry resistances and condensers, dial and knobs. Case finished in brown crackle. Dial calibrated 150-550 metres, 5 valves to suit. One each, either GT or metal; 6SA7, 6R7, 6V6, 6K7 0Z4. LASKY'S PRICE £5/5/-. Carriage 5/- extra. Or less valves, 69/6. Carriage 5/- extra. Other chassis in various conditions of completion are available for personal callers only. CIRCUIT for 5 valve car radio, using above chassis. PRICE 1/6.

Extensive range of Goodmans and Wharfedale speakers available from stock. Immediate delivery. Some examples.

GOODMANS 12in.
Audiom 60, 15-watt **£8/12/6.**
Axiom 150. Mk. II. 15-watt. **£10/5/6.**
Axiom 22. Mk. II. 20-watt. **£14/14/-.**
H.6 30-watt output trans. To customer's impedance. **£4.**

WHARFEDALE
Super 5 **£6/13/3.**
8in. Bronze **£3/3/11.**
Super 8 **£5/13/3.**
Super 8/CS/AL. **£6/13/3.**
Bronze 10 **£4/12/8.**
Golden 10 **£7/13/3.**
Super 12/CS/AL. **£17/10/-.**

"THE HARROW" Baffle Radio Cabinet

Build a second set to be proud of. Pleasing design cabinet, with drilled chassis, dial, drive and back. Finished in satin mahogany veneer. Outside dims.: 17½in. wide, 11½in. high, 5in. deep.

LASKY'S PRICE **36/6**
Carriage 2/-.

Receiver design uses 2-6K7, 6V6 and 5Z4. Total cost to build is less than £5/10/-.

Circuit for receiver 1/6.

R.1155 RECEIVERS

NOW AVAILABLE ON H.P. TERMS

BRAND NEW AERIAL TESTED BEFORE DESPATCH

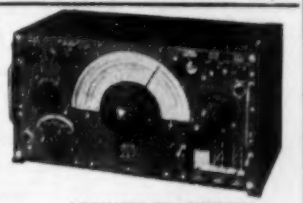
These well-known Ex-Air Ministry Receivers need no further introduction. Supplied complete with 10 valves and full circuit data.

LASKY'S PRICE BRAND NEW **£11.19.6**

Secondhand. Specially Selected. Grade 1 **£9.19.6**

Secondhand. Grade 2 **£7.19.6**

Carriage 17/6 per receiver extra, including 10/- returnable on case.



ASSEMBLED POWER PACK/OUTPUT STAGE FOR R.1155 RECEIVER

For use on 200-250 v. A.C. mains. Complete with 2 valves. In metal case size: 12 × 7 × 5½in.

LASKY'S PRICE, 79/6. Carr. 5/-.

Power Pack as above. Fitted with 6½in. p.m. speaker.

LASKY'S PRICE £5/5/-. Carr. 5/-.

A LASKY'S RADIO ADVERTISEMENT. SEE OVER.

LASKY'S RADIO

LASKY'S RADIO—NEW BRANCH at 42, TOTTENHAM COURT ROAD, LONDON, W.1

Telephone: MUSeum 2605 & LANgham 1152.
ONE MINUTE FROM TOTTENHAM COURT ROAD AND GOODGE STREET UNDERGROUND STATIONS

ALL OUR USUAL LINES PLUS EVERYTHING FOR THE SERVICEMAN, HAM AND HOME CONSTRUCTOR.

RADIO, TELEVISION, HI-FI, ELECTRONICS, P.A. EQUIPMENT, RECORDERS, ETC.

Wharfedale, Stentorian, Goodmans, Baker's, Leak, Cosmocord, Vitavox, Hunts, T.C.C., Dubilier, Garrard, Collaro, G.E.C., Wearite, Grundig, etc., etc.

NOW OPEN!

SAVE MONEY AT LASKY'S

SPECIAL OPENING OFFER. FOR PERSONAL CALLERS ONLY. Moving coil microphones. Switch incorporated. Listed at £5/5/-. LASKY'S PRICE **59/6**

HIGH VOLTAGE E.H.T. CONDENSERS

.1 + .1 mfd. 3.5 Kv.	5/11
.1 mfd. 7 Kv.	15/-
.001 mfd. 12.5 Kv.	7/6
.001 mfd. 15 Kv.	10/-
.0005 mfd. 10 Kv.	3/6
.0005 mfd. 15 Kv.	6/6
.04 mfd. 12.5 Kv.	5/-

CO-AXIAL CABLE
75-80 ohms impedance.
Single Core, per yard ..... 8d.
Twin Core, per yard 1/-
Twin Balanced Feeder, per yard ..... 6d.

CRYSTAL DIODES. Glass type, wire ends. 1/6 each. Higher Grades Available. 12 Assorted for 30/-. Post Free.

TELEVISION CABINETS

THE ROTHESAY

This cabinet is really the last word in outstanding contemporary design. Absolutely rigid construction throughout with the finest laminated woods, veneered in walnut, polished light, medium or dark shade. Fitted with gold anodised speaker grille. The C.R.T. aperture frame is detachable, supplied to suit any size tube to order. Full length doors if required can be supplied with the cabinet. Veneered both sides, and polished to match the cabinet, they will be mounted with full length piano hinges.
Outside dim. 34½in. high, 21⅝in. wide, 21½in. deep. Inside dim. 18⅛in. wide, 19½in. deep. Size of top 22⅛in. × 21⅛in. Thickness ½in. NOTE THESE GENEROUS SIZES.

LASKY'S PRICE **£9.19.6**
Carriage 15/- extra.

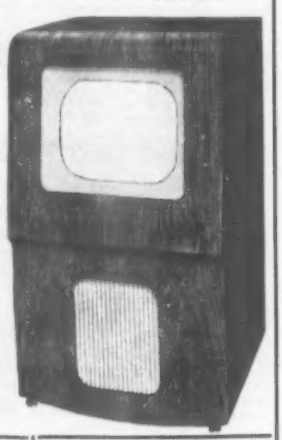
H.P. TERMS. Deposit £3/10/- plus carriage charge. Balance plus charges spread over 12 months.
The Rothesay cabinet with doors. Price £14/9/6.

Now supplied complete with mask, glass, castors, shelf, bearers, C.R.T. neck end protector, back, speaker fret and baffle board. Finished in beautiful figured medium, light or dark walnut veneer, with high polish. Suitable for most home constructor T.V. receivers, including the "Viewmaster," "Practical Television," "Tele-King," "Magniview," "Wireless World," etc. Can be supplied with cut-out for 14in., 16in. and 17in. C.R. tubes at no extra cost.

An allowance of **4s. 6d.** will be made if the mask is not required.
Inside Dimensions: Depth 16½in.; width 17⅝in.; height 28in. Overall height 32in. and width 18⅛in.
WHY NOT CONVERT YOUR TABLE RECEIVER TO A CONSOLE MODEL?
Adaptor frames for fitting 9in. or 10in. C.R. tubes can be supplied if required.

LASKY'S PRICE **£8.10.0**
Carriage 12/6 extra
H.P. Terms. Deposit £2/17/-, plus carriage. Balance plus charges spread over 12 months.

THE DE-LUXE



C.R.T. Neck Protectors 2/6.

SPECIAL T.V. CONDENSERS

64 mfd. 450 v.w.	3/11
100 mfd. 450 v.w.	4/11
32 + 100 mfd. 450 v.w.	7/6
100 + 200 mfd. 350 v.w.	5/11

TABLE MICROPHONE STANDS.
2 Section Chrome. Heavy base. 12/6.

MICROPHONE FLOOR STANDS. 2 Section Chrome. Heavy Base. 35/-.

METROSILS. 10 Kv. 5/-.

BRIMISTORS.
CZ.1 1/6 each. CZ.3 9d. each.

OUTPUT TRANSFORMERS

Midget Pentode	3/6
Miniature Personal, 3S4, etc.	3/6
Standard pentode	3/11
Push-Pull 6V6	9/6
Multi Ratio, P.P	12/6
Heavy Duty, P.P.	14/11

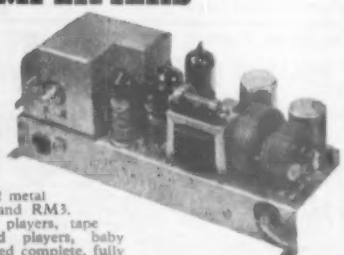
ELECTROLYTIC CONDENSERS ALL BRAND NEW

8 mfd. 450 v.w.	1/9
16 mfd. 350 v.w.	2/6
16 mfd. 500 v.w.	3/6
20 mfd. 500 v.w.	3/6
30 mfd. 450 v.w.	3/3
60 mfd. 350 v.w.	3/11
64 mfd. 450 v.w.	3/11
150 mfd. 350 v.w.	3/6
400 mfd. 150 v.w.	2/6
8 + 8 mfd. 450 v.w.	3/6
8 + 16 mfd. 450 v.w.	4/3
12 + 12 mfd. 350 v.w.	2/6
16 + 16 mfd. 350 v.w.	3/6
16 + 16 mfd. 450 v.w.	4/6
20 + 20 mfd. 275 v.w.	2/-
60 + 100 mfd. 350 v.w.	7/6
32 + 32 mfd. 450 v.w.	5/11

MANY OTHER SINGLE AND MULTIPLE CONDENSERS IN STOCK.

3-WATT AC/DC MIDGET AMPLIFIERS

Push pull, very high gain



4 valves: 2 UL41 in push pull, 1 UCH42 and 1 UAF42. Input voltage 100/110 AC/DC. Very easily converted to 230 volts. Supplied with circuit diagram and full details. Size:—9 x 4 x 4 inches. Uses 2 metal rectifiers, 1 each RM2 and RM3. Ideal for ships' record players, tape recorders, home record players, baby alarms, etc., etc. Supplied complete, fully assembled and wired, with 4 valves. Highest quality miniature components used throughout. An auxiliary 60 m/a. output is fitted, for use with a radio feeder. etc.

BRAND NEW AND UNUSED. IN MAKER'S CARTONS.

65/-
CARRIAGE FREE

THE TELE KING

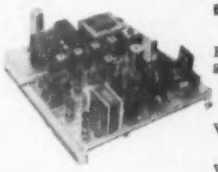
5 CHANNEL 16 or 17 INCH SUPERHET RECEIVER

WIDE ANGLE — LARGE SCREEN

Do you know . . . this famous and well tried home constructor set can now be built for £29/10/- including valves. Only tube and cabinet extra.

LASKY'S RADIO

A MULTI CHANNEL TUNER FOR THE TELE KING WILL BE AVAILABLE SHORTLY.



EVERY COMPONENT CAN BE SUPPLIED SEPARATELY.

Full constructional data, wiring diagrams and circuits.

Price 6/- POST FREE

WRITE NOW FOR OUR NEW TELE KING PRICE LIST.
WE CAN SAVE YOU MONEY.

CHOKES

40 m/a. . .	3/3	120 m/a.	7/3
60 m/a. . .	3/11	200 m/a.	12/6
80 m/a. . .	4/11	250 m/a.	14/-

SPECIAL TRANSFORMER
Secondary tapped as follows: 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 20, 24 and 30 volts at 2 amps. **PRICE** 17/6.

TELEVISION SELENIUM RECTIFIERS
The very latest "Sentercell" S.T.C. range

K3/40, 3.2 kV	6/-
K3/45, 3.6 kV	8/2
K3/50, 4.0 kV	8/8
K3/100, 8.0 kV	14/8
K3/160, 12.8 kV	21/6
K3/200, 16 kV	26/-

MANUFACTURER'S SURPLUS
R.F. E.H.T. OSCILLATOR COILS
Doubler type, 6-9 kV. Uses 1 or 2 EY51's. **LASKY'S PRICE 12/6.**

HEARING AIDS
By well known manufacturer. In metal case 2½ × 4½ × 1in. Complete with batteries and 3 subminiature valves. Fitted with internal crystal microphone. Used and soiled condition. **LASKY'S PRICE 39/6.** Post 2/6.
Earpiece and Cord. For use with hearing aid. **LASKY'S PRICE 17/6.**

INTERCOM. UNITS
4-station operation. For use on A.C./D.C. mains 200-250 volts. Complete, with 3 valves. Fitted in attractive plastic cabinet. **MASTER UNIT £5/19/6.** Carr. 5/- extra.
Extension Units, Price 21/- each complete. Carriage 2/- each extra.

P.M. LOUDSPEAKERS
All with 3 ohm speech coil.
3½in., 14/6. 5in., 14/6. 8in., 19/11. 4in., 12/6. 6½in., 15/-. 10in., 19/6.

ENERGISED SPEAKERS
8in. with O/T 600 ohm field, 15/6
8in. less O/T 600 ohm field, 12/6
8in. less O/T 1,200 ohm field. 12/6. 6½in. with O/T 600 ohm field, 14/-.

SPECIAL OFFER. 12 INCH CATHODE RAY TUBES.
Standard types, suitable for T.V. LIMITED QUANTITY. **LASKY'S PRICE £12/19/6.** Carriage and insurance 15/- extra.

ION TRAPS. All types, 3/-.

ARMOUR PLATE GLASS

16in. Actual size 17½in. × 15½in. × ⅛in.	7/11
15in. Actual size 16½in. × 13in. × ⅛in.	6/11
12in. Actual size 13in. × 10½in. × ⅛in.	4/-
9in. Actual size 9in. × 8in. × ⅛in.	3/-

TRIPLEX DARK SCREEN FILTERS

14 × 12½ × ⅛in.	7/6
15½ × 13½ × ⅛in.	9/6

Postage and packing 5/- per piece extra. (This charge is necessary owing to extra packing required).

PERSPEX IMPLOSION GUARDS, incorporating escutcheon and filter plate.

12in.	7/6
12in. de Luxe	15/-
16in. de Luxe	17/6

C.R.T. MASKS. Brand New LATEST ASPECT RATIO

9in.	7/-
10in.	7/6
12in. Rubber	15/-
12in. Old Ratio	9/6
12in. Escutcheon mask, with Perspex filter	12/6
14in. Rectangular	12/6
15in. Cream rubber	17/6
16in. Plastic, white	12/6
17in. Rectangular	15/-

TELESCOPIC AERIAL MASTS
As previously advertised Complete. **LASKY'S PRICE 25/-** Carriage 2/6 extra.

MANUFACTURERS' SURPLUS T.V. COMPONENT BARGAINS

WIDE ANGLE 38mm.

Line E.H.T. trans., ferroxcube core. 9-16 kV	25/-
Scanning Coils, low imp. line and frame	25/-
Frame Output Transformer	10/6
Scanning Coils low imp. line and frame	17/6
Frame blocking osc. transformer	4/6
Line Blocking osc. transformer, caslam cored	4/6
Focus Magnets Ferroxdure	25/-
P.M. Focus Magnets. Iron Cored	19/6
Duomag Focalisers	29/6
300 m/a. Smoothing chokes	15/-
Electromagnetic focus coil, with combined scan coils	25/-

STANDARD 35mm.

Line Output Transformers. No. E.H.T.	12/6
Line Output Transformers. 6-9 kV. E.H.T. and 6.3 v. winding. Ferroxcube	19/6
Scanning coils. Low imp. line and frame	12/6
Scanning Coils. Low imp. line and frame, by Igranic	14/6
Line blocking oscillator transformer	4/6
Frame blocking oscillator transformer	4/6
Frame output transformer	7/6
Focus Magnets: Without Vernier	12/6
With Vernier	17/6
Focus Coils. Electromagnetic	12/6
200 m/a. Smoothing chokes	10/6

AERIAL ROD SECTIONS
Steel, heavily copper plated. 12in. long, ⅛in. diameter. Any number may fitted together. **PRICE** 2/6 per doz. POST FREE.

MAINS TRANSFORMERS
All 200-250 v. 50 c.p.s. primary Finest quality, fully guaranteed.
MBA/3. 350-0-350 v. 80 mA. 6.3 v. 4 a., 5 v. 2 a. Both filaments tapped at 4 volts. An ideal replacement trans. **18/-.**

MBA/6. 325-0-325 v. 100 mA. 6.3 v. 3 a., 5 v. 2 a. With mains tapping board. Price **22/6.**

MBA/7. 250-0-250 v. 80 mA. 6.3 v. 3 a., 5 v. 2 a. Both filaments tapped at 4 volts. **18/-.**

MBA/8. SPECIAL OFFER
Drop through type. 235-0-235 v. 60 mA. 6.3 v. 3 a., **12/6.**

MBA/9. 400-0-400 v. 60 mA. 6.3 v. 1 a., 4 v. 2.5 a. Price **12/6.**
AT/3. Auto transformer. 0-10-120, 200-230-240 volts 100 watts Price **17/6.**

CLOSED FIELD SPEAKERS
6½in. **15/6**
8in. round and 6½in. Eliptical. **19/11.**

CYLDON 5-CHANNEL SWITCHED TELETUNERS

Brand new. Instant and positive selection of any one of the 5 B.B.C. television channels, by a single control knob. Uses EF.80 or 6BW7 RF pentode and ECC81 or 12AT7 Double Diode Triode as frequency changer. Tuning is obtained by switching incremental inductances. Size 4½ × 2½ × 2½in. Spindle 2½in. long ¼in. diameter. I.F. Output 9.5-14 Mc/s., noise figure on all channels better than 10.5dB., I.F. rejection better than 45dB. on all channels. Power gain 24dB. **LASKY'S PRICE,** less valves, 12/6. POST FREE.
Complete with valves. 37/6 POST FREE.

TAPE RECORDER AMPLIFIERS. Complete with 5 valves: 2 6SN7, 2 6V6, 1 5Z4. Twin inputs, also volume control and record level. On aluminium chassis, size 11½ × 2½ × 9in. Complete with valves and 8in. speaker. Totally enclosed in case. **LASKY'S PRICE £9/19/6.**
Less cover **£8/15/-.**
Less cover and head lift transformer **£7/15/-.** Carriage 5/- per unit extra.

LASKY'S RADIO

LASKY'S (Harrow Road) Ltd.,
370 HARROW RD., PADDINGTON, LONDON, W.9 (Opposite Paddington Hospital)
Telephone: CUNningham 1979/7214.

Another branch for personal callers:—42 TOTTENHAM COURT ROAD, LONDON, W.1.
Telephone: MUSeum 2605 & LANgham 1152. **Please Add a Reasonable Amount For Postage.**

SELENIUM RECTIFIERS

L.T. Types

2/6 v. ½ a.h.w....	1/9
6/12 v. ½ a.h.w....	2/9

F.W. Bridge Types

6/12 v. 1 a.....	5/9
6/12 v.1. 5 a	7/9
6/12 v. 2 a.....	9/9
6/12 v. 3 a.....	12/3
6/12 v. 4 a.....	14/9
6/12 v. 6 a.....	19/9
6/12 v. 10 a.....	29/9

H.T. Type H.W.

120 v. 40 mA....	3/11
250 v. 50 mA....	5/9
250 v. 80 mA....	7/9
RM3 125 v. 100 mA	3/11
RM3 125 v. 120 mA	5/9
RM4 250 v. 250 mA	11/9
300 v. 275 mA.	12/11

CO-AXIAL CABLE. 75 ohms ¼in., 7d yard. Twin screened feeder, 9d. yd.

RHEOSTATS (VARIABLE RESISTORS) 2 ohms 5 amps, 6/9; 0.4 ohm 25 a., 8/9; 10 ohm 3 amps., 8/9; 60 ohms 1.5 amps, 14/9.

SILVER MICA CONDENSERS. 5, 10, 15, 20, 25, 30, 35, 50, 100, 120, 150, 180, 200, 230, 300, 330, 400, 470, 500, 1,000 pfd. (.001μF), .002 mfd. (2,000 pfd.). All at 8d. each, 3/9 dozen one type.

DIAL BULBS, M.E.S., 8 v. 0.15 a., 6/9 doz., 6.5 v. 0.15 a., 6/9 doz. 4.5 v. 0.3 a., 6/9 doz.

ELECTROLYTICS (Current production) NOT ex Govt.

Tubular Types

8μF 450 v.....	1/11
8 mfd. 500 v....	2/6
16μF 350 v.....	2/3
16μF 450 v.....	2/9
16μF 500 v.....	3/9
24μF 350 v.....	3/3
32μF 350 v.....	3/9
32 mfd. 500 v....	5/9
8-16μF 500 v.	4/11
25μF 25 v.....	1/3
50μF 12 v.....	1/3
50μF 50 v.....	2/3

Can Types

8 mfd. 350 v....	1/3
8 mfd. 450 v....	2/3
8 mfd. 500 v....	2/9

Can Types

16 mfd. 350 v....	1/11
16μF 450 v.....	2/9
24μF 350 v.....	2/11
32μF 350 v.....	2/11
32 mfd. 450 v....	4/9
64 mfd. 450 v....	4/9
8-8μF 350 v....	3/9
8-8μF 450 v....	3/11
8-8 mfd. 500 v.	4/9
8-16μF 450 v....	2/11
16-16μF 450 v.	4/11
16-32μF 350 v.	4/9
16-32 mfd. 450 v.	4/9
32-32μF 350 v.	4/9
32-32μF 450 v.	5/11

AMPLIFIER OR CHARGER CASES. Size 14½ × 5½ × 7½in. high. Strongly made in perforated steel. Grey enamel finish. Only 9/6.

VOLUME CONTROLS with long spindles, all values, less switch, 2/9; with S.P. switch, 3/9.

WIRE WOUND POTS: 20 ohms, 500 ohms, 5K, 20K, 50K, 100K (medium length spindles), 2/9. 220 ohms, 2K, 10K, 20K, 50K, Preset type, 1/9 ea.

AMMETERS. Moving coil. G.E.C. 0—5 amps., 2in. scale, 11/9.

EX-GOVT. E.H.T. SMOOTHING CONDENSERS

.25 mfd. 4,000 v. Blocks	4/9
.5 mfd. 2,500 v. Blocks	3/9
.5 mfd. 3,500 v. Cans	3/3
.1 mfd. plus 1 mfd. 8,000 v., large blocks (common negative isolated)	9/6
1.5 mfd. 4,000 v. blocks	5/9

EX-GOVT. ACCUMULATORS with non-spill vents Unused and guaranteed. 2 v. 16 A.H. 5/9 each

EX-GOVT. BLOCK PAPER CONDENSERS

2 mfd. 800 v.	1/9	4 mfd. 2,000 v.	6/9
4 mfd. 500 v.	2/9	6-6 mfd. 450 v ...	5/9
4 mfd. 730 v.	3/9	8 mfd. 500 v.....	5/9
4 mfd. 1 500 v. ...	4/9	8-8 mfd. 500 v....	6/11
		15 mfd. 500 v.....	7/9

4 mfd. 400 v. plus 2 mfd. 250 v. 1/11.

EX-GOVT. AUTO TRANSFORMERS 50 c/s.

15-10-5-0-195-215-235 v., 500 watts	27/9
Double Wound 220/240 v. input. Output 57.5 v. to 230 v. 21 amps in steps of 11 v.	60/15
Double Wound 10-0-200-220-240 v. to 10-0-275-295-315 v. 1,000 watts.....	69/6
0-110-190-230 v. 1,400 watts	49/6

M.E. SPEAKERS. All 2-3 ohms, 6¼in. Rolafield 700 ohms, 11/9. 8 in. R.A. field, 600 ohms, 11/6. 10in. R.A. field 1,500 ohms 23/9. 10in. R.A. field 1,000 ohms, 23/9. **SPECIAL OFFER.** Mains Trans. 200-250 v. 50 c/s. Primary. Secs. 300-0-300v. 150 mA. 6.3 v. 4 a, 5 v. 3 a., Half shrouded drop through, 21/9.

H.T. ELIMINATOR AND TRICKLE CHARGER KIT with case. Mains input 200-250 v. Output 120 v. 40 mA. and 2 v. ½ a. Price with circuit 29/6. Or in working order, 37/6.

R.S.C. TRANSFORMERS

FULLY GUARANTEED, INTERLEAVED AND IMPREGNATED

MAINS TRANSFORMERS
Primaries 200-230-250 v. 50 c/s.

FULLY SHROUDED UPRIGHT MOUNTING

250-0-250 v. 60 mA., 6.3 v. 2 a., 5 v. 2 a., Midget type, 2½-3-3in.	15/9
350-0-350 v. 70 mA., 6.3 v. 2 a., 5 v. 2 a....	18/6
250-0-250 v. 100 mA., 6.3 v.-4 v. 4 a., c.t., 0-4-5 v. 3 a.	23/6
250-0-250 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a...	22/9
250-0-250 v. 100 mA., 6.3 v. 6 a., 5 v. 3 a., for R1355 conversion	29/6
300-0-300 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a...	27/9
300-0-300 v. 100 mA., 6.3 v.-4 v. 4 a. c.t., 0-4-5 v. 3 a.	33/6
350-0-350 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	22/9
350-0-350 v. 100 mA., 6.3 v.-4 v., 4 a. c.t., 0-4-5 v. 3 a.	23/9
350-0-350 v. 150 mA., 6.3 v. 4 a., 5 v. 3 a.	31/6
350-0-350 v. 150 mA., 6.3 v. 2 a., 6.3 v. 2 a., 5 v. 3 a.	33/9
350-0-350 v. 250 mA., 6.3 v. 6 a., 4 v. 8 a., 0-2-6 v. 2 a., 4 v. 3 a., for Electronic Eng. Televisor	55/6
425-0-425 v. 200 mA., 6.3 v. 4 a., c.t., 6.3 v. 4 a., c.t., 5 v. 3 a., suitable Williamson Amplifier, etc.	47/9
425-0-425 v. 250 mA., 6.3 v. 6 a., 6.3 v. 6 a., 5 v. 3 a.	65/6

TOP SHROUDED DROP THROUGH TYPE

250-0-250 v. 70 mA., 6.3 v. 2.5 a.	12/11
260-0-260 v. 70 mA., 6.3 v. 2 a., 5 v. 2 a....	15/9
350-0-350 v. 80 mA., 6.3 v. 2 a., 5 v. 2 a....	17/6
275-0-275 v. 80 mA., 6.3 v. 3 a., 4 v. 2.5 a.	14/11
250-0-250 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	21/9
300-0-300 v. 100 mA., 6.3 v.-4 v. 4 a., c.t., 0-4-5 v. 3 a.	21/9
350-0-350 v. 100 mA., 6.3 v. 4 a., c.t., 5 v. 3 a.	21/9
350-0-350 v. 150 mA., 6.3 v. 2 a., 6.3 v. 2 a., 5 v. 3 a.	29/11
350-0-350 v. 150 mA., 6.3 v. 4 a., 5 v. 3 a.	26/9

E.H.T. TRANSFORMERS. 2,500 v. 5 mA., 2-0-2 v. 1.1 a., 2-0-2 v. 1.1 a., for VCR97, VCR517 or ACR2X. 36/6

FILAMENT TRANSFORMERS
Primaries 200-250 v. 50 c/s.

6.3 v. 1.5 a.....	5/9	0-4-6.3 v. 2 a....	7/9
6.3 v. 3 a.	8/11	6.3 v. 6 a.	17/6
12 v. 1 a.	7/11		
0-2-4-5-6.3 v. 4 a.	10/9	12 v. 3 a. or 24 v.	
6.3 v. 2 a.	7/6	1.5 a.	17/6

CHARGER TRANSFORMERS
All with 200-230-250 v. 50 c/s Primaries: 0-9-15 v. 1.5 a., 12/9; 0-9-15 v. 3 a., 16/9; 0-9-15 v. 6 a., 22/9; 0-4-9-15-24 v. 3 a., 22/9.

ELIMINATOR TRANSFORMERS

Primaries 200-250 v. 50 c/s, 120 v. 40 mA.	7/11
120 v. 40 mA. 5-0-5 v. 1 a.	14/9

OUTPUT TRANSFORMERS

Midget Battery Pentode 66 : 1 for 3S4, etc.	3/6
Small Pentode, 5,000Ω to 3Ω	3/9
Standard Pentode 5,000Ω to 3Ω	4/6
Standard Pentode, 8,000Ω to 3Ω	4/9
Standard Pentode, 10,000 ohms to 3 ohms	4/9
Multi-ratio 40 mA. 30 : 1, 45 : 1, 60 : 1, 90 : 1, Class B Push-Pull	5/6
Push-Pull 8 Watts 6V6 to 3 ohms	8/9
Push-Pull 10-12 Watts 6V6 to 3Ω or 15Ω	15/9
Push-Pull 10-12 Watts to match 6V6 to 3-5-8 or 15Ω	16/9
Push-Pull 15 Watts 6L6s, KT66s, etc. to 3 or 15 ohms	19/9
Push-Pull 20 Watts high-quality sectionally wound 6L6, KT66, etc., to 3 or 15Ω	47/9
Williamson type, exact to author's spec.	85/-

SMOOTHING CHOKES

250 mA., 3 H. 50 ohms	11/9
150 mA., 7-10 H. 250 ohms	11/9
100 mA., 10 H. 200 ohms	8/9
80 mA., 10 H. 350 ohms	5/6
60 mA., 10 H. 400 ohms	4/11
50 mA., 40 H. 1,000 ohms. Potted	10/9
20 mA., 30 H. 1,000 ohms	4/9

MICROPHONE TRANSFORMERS

100:1	5/9

THE SKY CHIEF T.R.F. RECEIVER

A design of a 4-stage, 3 valve 200-250 v. A.C. Mains receiver with selenium rectifier. For inclusion in any of cabinets illustrated above. It consists of a variable Mu high gain H.F. stage followed by a low distortion grid detector triode The next stage is a further triode amplifier with tone correction by negative feedback. Finally comes the output stage consisting of a parallel connected double triode giving ample output at an extraordinary low level of distortion. Point to point, wiring diagrams instructions, and parts list, 2/6. This receiver can be built for a maximum of £4/10/- including cabinet.

P.M. SPEAKERS. All 2-3 ohms. 5in. Goodmans, 15/9. 6½in. Plessey 16/9. 8in. Plessey, 15/9. 10in. R.A., 26/9. 10in. Plessey 18/6. 10in. Rola with Trans. 29/6.

R.S.C. BATTERY CHARGER KITS. For mains input 200-250 v. 50 c/s. To charge 6 v. accumulator at 2 amps., 25/9. To charge 6 v. or 12 v. battery at 2 a., 31/6. To charge 6 v. or 12 v. battery at 4 a., 49/9. ABOVE KITS CONSIST OF BLACK CRACKLE LOUVRED STEEL CASE, MAINS TRANSFORMER, FULL WAVE METAL RECTIFIER, FUSES, FUSE-HOLDERS AND CIRCUIT. Any type assembled and tested for 6/9 extra.

ASSEMBLED BATTERY CHARGER. For Mains 200-250 v. 50c/s. Variable output up to 4 amps., at 6 v. or 12 v. Fitted with 5 amp. Meter. Attractive crackle finished case, 69/6.

EX. GOVT. MAINS TRANSFORMERS
All 230 v. 50 c/s. input

250-0-250 v. 40 mA., 6.3 v. 2 a., 5 v. 2 a.	9/11
8.8 v. 4 a.	9/9
48 v. 1 a.	9/6
0-11-22 v. 15 a.	35/9
0-11-22 v. 30 a.	72/6
16-18-20 v. 35 a.	79/6
7.7 v. C.T. 7 amps 4 times	25/9
460 v. 200 mA., 6.3 v. 5 a.	27/9
365-0-365 v. 150 mA	8/9
300-0-300 v. 86 mA. 5 v. 3 a.	9/11
278-0-278 v. 100 mA.	8/9
300-0-300 v. 150 mA., 610-0-610 v. 150 mA., 1,220 v. 350 mA.	29/9
400 v. C.T. 150 mA. 4 v. 6 a., 6.3 v. 6 a., 6.3 v. 0-6 a., 4 v. 6 a., 4 v. 3 a., 4 v. 3 a., 4 v. 3 a., 5 v. 2 a.	22/9

EX-GOVT. SMOOTHING CHOKES

250 mA., 10 H. 50 ohms	14/9
250 mA. 10 H. 100 ohms	14/9
250 mA. 3 H. 50 ohms	8/9
150 mA. 10 H. 50 ohms	10/11
100 mA.*10 H. 100 ohms, Tropicalised	6/9
100 mA. 5 H. 100 ohms. Tropicalised	3/11
50 mA. 50 H. 1,000 ohms. Potted	8/11
90/100 mA. 10 H. 100 ohms. Potted	8/9
50 mA. 5-10 H.	2/9
L.T. type 1 amp.	2/9

EX-GOVT. TRANSMITTER-RECEIVER TYPE TR9D, complete with all valves, only 47/9, plus carr. 5/-.

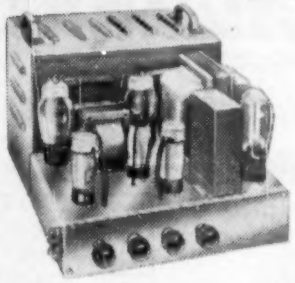
CHASSIS

18 s.w.g. undrilled aluminium amplifier type (4-sided).	16 s.w.g. aluminium, receiver type.
12in. × 9in. × 2¼in. 6/11	12in. × 8in. × 2¼in. 5/3
14in. × 9in. × 2¼in. 6/11	16in. × 8in. × 2¼in. 7/6
14in. × 10in. × 3in. 7/11	20in. × 8in. × 2¼in. 8/11
16in. × 10in. × 3in. 8/3	
18 s.w.g. aluminium receiver type.	16 s.w.g. aluminium, amplifier type, 4-sided.
6in. × 3½in. × 1¼in. 1/11	12in. × 8in. × 2¼in. 7/11
7¼in. × 4½in. × 2in. 2/9	16in. × 8in. × 2¼in. 10/11
10in. × 5¼in. × 2in. 3/3	20in. × 8in. × 2¼in. 13/6
11in. × 6in. × 2¼in. 3/11	14in. × 10in. × 3in. 13/6

R.S.C. HIGH FIDELITY 25 watt AMPLIFIER A 4

A NEW DESIGN FOR 1955

HIGH GAIN "PUSH PULL OUTPUT." BUILT-IN PRE-AMP. TONE CONTROL STAGES. INCLUDES 7 B.V.A. valves, sectionally wound output transformer, block paper reservoir condenser, and reliable small components. AN INPUT OF ONLY 20 millivolts IS REQUIRED FOR FULL OUTPUT. THIS MEANS THAT ANY TYPE OF MICROPHONE OR PICK-UP IS SUITABLE. Two separate inputs controlled by separate volume controls allow simultaneous use of "Mike" and Gram., or Tape and Radio, etc., etc. Individual controls for Bass and Treble "lift" and "cut." Six negative feedback loops giving total of 24 D.B. Frequency response ± 3 D.B. 30-20,000 c/cs.



Hum level 66 D.B. down. Certified total harmonic distortion of only 0.35% measured at 10 watts. Comparable with the very best designs. SUITABLE FOR SMALL HOMES OR LARGE HALLS, CLUBS, GARDEN PARTIES, DANCE HALLS, etc., etc. For ELECTRONIC ORGAN OR GUITAR. For STANDARD OR LONG PLAYING RECORDS. Size approx. 12in. × 10in. × 9in. Weight 20 lb. Power consumption 175 watts. Outputs for 3 and 15 ohms speakers. The kit is complete in every detail. Chassis is fully punched. Easy to follow point-to-point wiring diagrams, are supplied. EXTRA HIGH SENSITIVITY, HIGHEST QUALITY for **9 Gns.**, plus carr. 7/6. Or assembled ready for use **50/-** extra.

H.P. terms now available on request.

W.B. "STENTORIAN" High fidelity P.M. Speaker, HF1012, 10 watts. 15 ohm (or 3 ohm) speech coil. Where a really good quality speaker at a low price is required we highly recommend this unit with an amazing performance. **£3/13/6.**

MICROPHONES. Crystal, hand type, good quality, **£2/19/6.** Stand type with base and adjustable stand, **£6/10/0.** Both suitable for use with our amplifiers.

PLESSEY 3-SPEED MIXER AUTOCHANGERS with high impedance magnetic pick-up with duo point alloy stylus for long playing or standard records. (Will play 2,000 records before replacement stylus required.) Brand new, cartoned, guaranteed. Limited stocks at only **10 gns.**, plus 5/- carr.

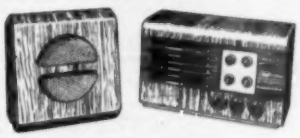
COLLARO TAPE DESK MOTORS. Shaded pole type. Clockwise or anti-clockwise. Mains input 110-200-250 v. **31/6.**

H.M.V. LONG PLAYING RECORD TURNTABLE COMPLETE WITH CRYSTAL PICK-UP (SAPPHIRE STYLUS). Speed 33⅓ r.p.m. BRAND NEW, CARTONED. Only **£3/19/6** (approx. half price). Carr. 5/-. (For 200-250 v. A.C. Mains).

A PUSH-PULL 3-4 WATT HIGH-GAIN AMPLIFIER FOR £3/7/6

For mains input 200-250 v. 50 c/s. Complete kit of parts including point-to-point wiring diagrams and instructions. Amplifier can be used with any type of feeder unit or pick up. This is not A.C./D.C. with "live" chassis but A.C. only with 400-0-400 v. Trans. Output is for 2-3 ohm speaker. (We can supply a very suitable 10in. unit by Rola at **27/6.**) The amplifier can be supplied ready for use for **25/-** extra. Full descriptive leaflet, **7d.**

R.S.C. TONE CONTROL-PRE-AMP. UNIT. A complete set of parts for the construction of a very efficient but simple pre-amplifier and tone control unit. For use with any amplifier and pick-up. Fil. supply self-contained. Size 7¼-5-5¼in. approx. Descriptive leaflet **9d.** Price, inc. wiring diagrams, **37/6.** Ready for use, **15/-** extra.



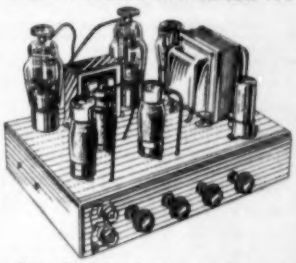
R.S.C. MASTER INTERCOMM. UNIT, with provision for up to 4 "Listen-Talk Back Units" individually switched. A high gain amplifier enables speech and other sounds emanating from the rooms containing remote control units to be heard at the master control. The unit is in kit form and point-to-point wiring diagrams are supplied. A walnut veneered wood or Brown Bakelite cabinet is included. Mains input is 200-250 v. 50 c/s. H.T. line 300 v. CHASSIS IS NOT "ALIVE" Ideal also for use as "Baby Alarm" Sound amplification 4 watts. Price only **£5/19/6.** "Listen—Talk Back Unit" in bakelite or walnut veneered cabinet, can be supplied at **30/-** each. Full descriptive leaflet **10d.**
The Master Unit can be supplied assembled and tested for **30/-** extra.

PERSONAL SET BATTERY SUPERSEDER KIT.

All parts for an "All Dry" Battery Eliminator. Complete with case. Supplies 90 v. 10 mA. and 1.4 v. 250 mA. fully smoothed, from normal. 200-250 v. 50 c/s mains. For 4-valve superhet receivers. Price with circuit, **35/9.** Or ready for use, **42/6.** Size of unit 5¼-4-1¼in.

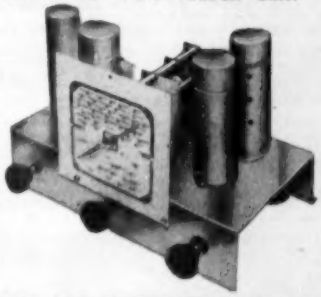
BATTERY SET CONVERTER KITS. All parts for converting any type of battery receiver to all mains. A.C. 200-250 v. 50 c/s. Kit will supply fully smoothed H.T. of 120 v. 90 v. or 60 v. at up to 40 mA., and fully smoothed L.T. of 2 v. at 0.4 a. to 1 a. Price complete with circuit and instructions only **48/9.** Supplied ready for use for **8/9** extra.

R.S.C. 10-watt "Push-Pull" HIGH-FIDELITY AMPLIFIER A 3



Complete with integral pre-amp. Tone control stage (as A11 amplifier), using negative feedback, giving humproof individual bass and treble lift and cut tone control. **Six Negative Feedback Loops.** Completely negligible hum and distortion. Only 130 millivolts input required for full output Frequency response ± 3 db. 30-20,000 c.p.s. Two independently controlled inputs. Six valves. A.C. mains 200-230-250 v. input only. Outputs for 3 or 15 ohms speakers. Kit of parts complete in every detail, **£7/19/6,** plus 5/- carriage, or ready for use, **45/-** extra. Descriptive leaflet **1/-.**

FOUR STAGE RADIO FEEDER UNIT.



Design of a HIGH FIDELITY, L. and M. wave T.R.F. Unit with self-contained heater supply and thorough H.T. decoupling. Only 250-400 v. 15-20 mA. H.T. required from main amplifier. Three valves and Low Distortion Germanium Diode Detector. Flat topped response characteristic. Loaded H.F. coils. Two variable Mu controlled H.F. stages, 3 gang condenser tuning. Cathode follower output stage. Switch position for Gram. and Gram. input and output sockets. Performance comparable with the best in Feeder Units. For A.C. mains 200-230-250 v. operation. Size 11-6-7½in. Illustration, full set of easy-to-follow wiring diagrams and instructions and individually priced parts list **2/6.** This unit can be built for only **£3/15/-,** including Dial and Drive Knobs and every item required.

Radio Supply Co. (LEEDS) LTD.

32 THE CALLS. — LEEDS, 2.

Terms C.W.O. or C.O.D. No C.O.D. under £1. Postage 1/- extra under 10/-, 1/6 extra under £3, 1/11 extra under £3. Full Price List 6d. Trade List 5d.
Open to Callers: 9 a.m. to 5-30 p.m. Saturdays until 1 p.m.

CLYNE RADIO LTD.

18, TOTTENHAM COURT ROAD, LONDON, W.1

MUSeum 5929/0095.

All goods specially selected for quality and value. Prompt Service—Money-back guarantee—It will pay you to visit our new rebuilt shop premises. Situated 50 yds. only from Tottenham Court Road Tube! (Genuine).

F.M.!! (Frequency Modulation)

We are pleased to announce our complete Kit for the "Dance" F.M. Feeder Unit.

This unit provides an A.F. output suitable for feeding into the audio section of a standard broadcast receiver where triode/pentode output are available. Within an average of 30 miles from a V.H.F. transmitter one I.F. stage should be adequate, but our complete Kit supplied includes all components and valves for an extra I.F. stage if necessary, or if the unit is used at greater distances. Full Constructional details, theoretical circuit, and point-to-point wiring diagram can be supplied for 1/6 post free, or the complete Kit right down to the last nut and bolt, at only £6/7/6, plus 2/6 packing and postage. This unit can be supplied if desired, ready assembled, aligned and tested, at £8/10/- plus 2/6 P. & P.

If required we shall be pleased to align this unit for constructors not possessing the necessary equipment, for a charge of 7/6. N.B.—Valve line-up is 6AM6, 12AH8, 2-6BA6 and 6AL5. Chassis measures only 6¼in. × 5¼in. × 1¼in. Demonstrations at 19, Tottenham Court Road!!

METERS

F.S.D.	Size	Type	Fitting	Price
50 microamp	D.C. 2in.	M.C.	R.P.	50/-
250 microamp	D.C. 2½in.	M.C.	F.R.	40/-
500 microamp	D.C. 2in.	M.C.	R.P.	13/6
500 microamp	D.C. 2in.	M.C.	F.R.	18/6
500 microamp	D.C. 2½in.	M.C.	F.R.	35/-
1 mA.	D.C. 2in.	M.C.	F. Sq.	17/6
1 mA.	D.C. 2in.	M.C.	F. Sq. (scale calib. 1.5 kV.)	15/-
1 mA.	D.C. 2½in.	M.C.	F.R.	22/6
1 mA.	D.C. 2½in.	M.C.	Desk Type	27/6
5 mA.	D.C. 2in.	M.C.	F. Sq.	7/6
10 mA.	D.C. 2½in.	M.C.	R.P.	8/-
10 mA.	D.C. 2½in.	M.C.	F.R.	10/-
15 mA.	D.C. 2in.	M.C.	F.R.	7/6
20 mA.	D.C. 2in.	M.C.	F.R.	7/6
50 mA.	D.C. 2in.	M.C.	F. Sq.	8/6
150 mA.	D.C. 2in.	M.C.	F. Sq.	7/6
200 mA.	D.C. 2½in.	M.C.	R.P.	10/-
500 mA.	D.C. 2in.	M.C.	R.P.	6/6
500 mA.	D.C. 2½in.	M.C.	F.R.	8/6
6.5 amp.	R.F. 2in.	Thermo	F. Sq.	4/6
1 amp.	R.F. 2½in.	Thermo	R.P.	10/-
3 amp.	R.F. 2in.	Thermo	F. Sq.	6/-
5 amp.	D.C. 2in.	M.C.	F. Sq.	12/6
6 amp.	R.F. 2½in.	Thermo	F.R.	7/6
20 amp.	D.C. 2in.		R.P. (with shunt)	10/6
15 volt	A.C. 2½in.	M.C.	F.R.	10/-
20 volt amp.	D.C. 2in.	M.C.	F. Sq.	7/6
15-0-15 volt	D.C. 2½in.	M.C.	F.R.	17/6
150 volt	D.C. 2in.	M.C.	F.R.	15/-
300 volt	D.C. 2in.	M.C.	F. Sq.	8/6

R.F. = Round projection. M.C. = Moving Coil. Thermo = Thermo-couple. F. Sq. = Flush Square. F.R. = Flush Round.

METER RECTIFIERS. 1 mA. by G.E.C., at 8/6, also 5 mA. by Westinghouse at 8/6.

EX-W.D. CATHODE RAY TUBES. Guaranteed full picture. VCR97 at 40/-. VCR517C at 35/-. Also VCR139A—Ideal for oscilloscope 2½in. screen at 35/-. We also have VCR97 with slight cut-off, very suitable for oscilloscope, testing purposes, etc., at 15/- only. All these tubes are brand new, in original packing, and tested before despatch. Please add 2/6 packing and carriage for any of the above tubes.

R.F. UNITS. All new condition and complete. Case size 9½in. × 7½in. × 5in.
Type 24.—20-30 Mc/s, 15/-, Switched Tuning. **Type 25**—40-50 Mc/s, 19/6. Switched Tuning.
Type 27—65-85 Mc/s, 25/-, Variable Tuning. **Type 26**—50-65 M/cs. Variable Tuning. 35/-.
We have a limited supply of RF27 new condition and complete, but tuning dial damaged. Price only 30/- each. ALL these units Post Free!!

TEST METER—EX ARMY. Direct readings 15 v. and 3 v. D.C., 6 mA. and 60 mA. D.C. current, 500 ohms and 5,000 ohms resistance ranges. Complete in bakelite case with web carrying strap. 19/6 plus 1/6 P. & P.

T1154 TRANSMITTER UNIT. Medium/high-powered for C.W.-M.C.W. R/T. 3 ranges, 10-5.5 Mc/s, 5-3.3 Mc/s, 500-200 Kc/s. Absolutely complete; 4 valves, 2 meters, hundreds of resistors, condensers, etc., in wooden transit case. Price 39/6, plus 7/6 carriage and packing.

D.C. TEST METER EX-AIR MINISTRY TYPE E, BY AVO. Instrument size 4½ × 3½in. × 1¾in. Black Bakelite case. Meter scale length 3in. D.C. volts, 2 v., 4 v., 20 v., 40 v., 200 v., 400 v., 1,000 v., 2,000 v. D.C. current, 20 mA., 100 mA., 200 mA., 2 amp., 20 amp. Resistance scale, 0-10,000 ohms. These meters have all been reconditioned, and are guaranteed perfect. Supplied complete in leather carrying case at £3/19/6, plus 2/- P. & P. Limited quantity.

R1155A RECEIVERS guaranteed serviceable in original packing cases. £7/19/6. Fully assembled Power Pack and output stage, to plug straight into R1155 for A.C. 200/250 volts, at 70/6. We have a few brand new R1155A at £11/19/6, also in original packing cases—Deduct 10/- if purchasing either receiver together with power pack. Plus 10/- packing and carriage.

L.T. TRANSFORMER — ADMIRALTY. Heavy duty type, 180/230 v. input, 4.2 v. plus 4.2 v. at 10 amp. 25/- only, plus 1/6 P. & P.

HEATER TRANSFORMERS. Special Manufacturers' surplus. Brand new, tropicalised by Woden, for instrument work: Primary 0/110 v., 220/240 v., 380/440 v. Secondaries 0/10 v./20 v./30 v./60 v./240 v. at 30 mA. 6.3 v. .45 A., 6.3 v. 0.9 A. 7/6 ea. only, plus 1/6 P. & P. Limited quantities.

HIRE PURCHASE
We are pleased to announce advantageous hire purchase facilities on any single item over £10. Ask for details, mentioning what you are interested in.

TAPE RECORDING EQUIPMENT. We can offer a well constructed cabinet handsomely finished in grey or brown resine made specifically to take Truvox or Wearite Tape Decks. Measures 22in. × 14in. × 9½in. deep. Completely portable, shows attractive speaker grille at one end, to take 8 in. speaker. This cabinet is especially made to take in addition to the above decks, the very latest ELPICO tape amplifier (Mk. V) at £16/16/-. Price of cabinet 79/6, plus P. and P.

N.B.—We can supply from stock the latest Truvox and Wearite Tape Decks at 99 guineas and £85 respectively. Reduction of 20/- on cabinet if purchased at the same time as either of these tape decks!!

N.B.—We can also supply from stock the astounding Truvox Radio Jack. Overall length 4½in. × 2½in. × 2¼in. Just plug into your tape recorder or any suitable amplifier to receive direct reception from any two local stations, or to make recordings (in the case of tape recorder) of any of the programmes radiated by the selected stations. Price only £3/8/4 tax paid, or send stamp for illustrated leaflet.

We also have in stock Elpico new tape deck at £19/19/-. Truvox Tape Amplifier type "C" at £16/16/- especially for use with Truvox Deck. Truvox Telephone adaptor at £2/2/-; also Dictation Attachment at £2/4/-.

SPECIAL PURCHASE. We can offer strictly limited supply of "Limpet" telephone tape recorder attachments. Simply stick rubber suction pad to base of telephone and plug in to input-jack on your tape recorder. This automatically records incomings telephone conversations. Our price absolutely complete with lead and jack plug. 17/6 only, post free!

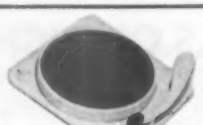
Manufacturer's surplus high-quality crystal microphone type HM7 for hand or stand use. A few only at 50/-, post free. We also have a limited number of Ronette twin cell crystal microphone inserts at 23/6.

Carrying cases in black leatherette finish. An extremely well-made case with chrome locks and corner pieces for extra strength. This cabinet will house any 12in. Hi-Fi speaker, but can be put to a number of uses. Front panel and lid are removable, and the cabinet is packed in a strong cardboard container for carrying purposes. Size: 18in. × 10½in. × 14½in. high. 55/-, plus 5/- post and packing.

45 Mc/s PYE STRIP.—Brand new complete with 6 valves type EF50 and one EA50. 70/- only.

METER SPECIAL! We have a limited quantity of aircraft electrical thermometers. Brand new, by Weston. 2in. moving coil meter, flush square fitting. These meters have a luminous scale graduated 40-140 degrees centigrade, but the full scale deflection is approximately 150 microamps! Price 12/6 each only, plus 1/- P. & P.

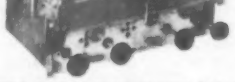
VIBRATOR PACK. Brand new, by Mallory. 12 volt input, 150 v. 40 mA. output. Complete with synchronous vibrator. 27/6.



SPECIAL PURCHASE!
DECCA THREE-SPEED GRAM UNITS

A three-speed quality single player motor complete with 10in. turntable and pickup, with the two famous ffrr magnetic plug-in heads type C and D, fitted with sapphire stylii. Modern Decca cantilever type counter-balanced pick-up arm. Matches the circuit of almost any radiogramophone or record reproducer. The first step towards the achievement of high-fidelity reproduction when used with amplifiers specially designed for this purpose. Automatic stop of entirely new design. Base-plate measures 12½in. × 11in. Height above motor board 2¼in. and 3in. clearance required below. List price £13/19/6, our price only £7/19/6 tax paid, plus 5/- packing and post. Cream finish. We can also supply this unit with the special "2-pin" to ACOS" adaptor and two GP19 heads. Price the same £7/19/6!

ANOTHER GRAM UNIT BARGAIN!
Collaro RC/851—3 record auto-changer, for 78 r.p.m. Brand new complete with separate plug-in magnetic head. Our price £8/8/- only, plus 5/- p. & p.
Collaro AC/514—Single record playing units for 78 r.p.m. Brand new in sealed cartons, with separate plug-in magnetic head. Our price £4/12/6 plus 3/- p. & p.



VERY SPECIAL HIGH-QUALITY RADIOGRAM CHASSIS. We have purchased a limited quantity of these chassis by Britain's leading manufacturers of quality radiograms. Circuit is a 3-waveband five-valve superhet with A.V.C. Valves 6K8G frequency-changer 6S8G I.F. amplifier, detector and A.V.C. 6S17GT. Combined pick-up amplifier and A.F. Amplifier on Radio and Gram. 6V6G, beam-power output tetrode; 5Z4G full-wave rectifier—Employing a special circuit for gramophone pre-amplification — A continuously variable tone-control provides ample treble correction without accentuating the bass. Large glass dial, horizontal tuning measuring 11in. × 3¼in. Chassis measurement: 14¼in. × 9in. × 8in. This is a superior chassis designed to sell originally in a Radiogram costing £79. Our price is £11/19/6 only, tax paid, plus 5/- packing and carriage. We will gladly demonstrate this chassis or any other working item from our stocks, to personal callers!

BRAND NEW C.R.T.S—By leading manufacturer. 14KP4A. Latest type 14in. rectangular 9.3 v. heater, 12-14 Kv. in original sealed cartons. Limited quantity only at £13/19/6 plus 15/- packing, carriage and insurance.

AMERICAN INDICATOR UNIT TYPE BC929A. Brand new incorporating 3in tube 3BP1, with mu-metal shield, 2-6SN7GT, 2-6H6GT, 6X5G, 2X2, 6G6G, 9 potentiometers, 24 v. aerial switch motor, transformer, and a host of small components. The whole unit which measures only 8¼in. × 8¼in. × 13¾in. is brand new, enclosed in black cracked box, and can be supplied at 85/- plus 5/- p. & p.

BATTERY CHARGER 6 12v 4A. Attractive grey and red metal case. Fused in and out. Full charge or half charge. Complete with heavy duty crocodile clips. Not Ex-Govt. Fully guaranteed. £4/19/6.

6-VOLT VIBRATOR PACK. Ex-W.D. 6-volt input, output 140 v. 30 mA. Fully smoothed and rectified, incorporating Wearite 6 volt 4 pin vibrator type N8B6. Unit size only 6¼in. × 5in. × 2¼in. Price 15/- plus 1/6 P. and P. New condition.

LIGHTWEIGHT CRYSTAL HEADPHONES. Brand new, by Rothernel. List price 70/-. Our Price 25/-!! Limited supply.

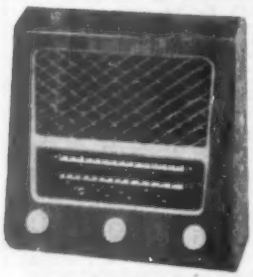
HEADPHONES. Brand new, ex-Govt., by S. G. Brown. Type CLR. Low resistance, 7/6 per pair. Type CHR high resistance, 12/6 per pair. We can also supply very special brand new American ex-Govt. lightweight high resistance phones by Trimm at 15/- per pair.

Please add postage under £1. C.O.D. or Cash with order. C.O.D. charge extra—open 9 a.m.–6 p.m, Monday to Friday. Sorry but we close at 1.0 p.m. on Saturday.

The R.C. RAMBLER ALL-DRY PORTABLE KIT

Full assembly details with practical and theoretical diagrams can be supplied at **1/6** post free. This is a truly professional 4-valve superhet—all dry—*for* medium and long waves. A cream plastic top panel, with dial engraved in red and green, adds to the very imposing appearance of this model wich is housed in an attractive cream and grey leatherette covered attache-case type cabinet, measuring only 9in. × 7in. × 5¼in. Weight (less batteries) 4¼ lb. with batteries 6¼lb. This set really has everything! Built - in frame aerial, high quality, extremely sensitive, and very adequate volume from the 5in. speaker. Valve line-up: 2V4, 1R5, 1S5, 1T4. All the required components, exactly as specified, including cabinet, can be supplied from stock at the special inclusive price of **£7/7/-** plus 2/6 P. & P. (less batteries). Use Ever Ready 90 v. H.T. type B126 at **9/3**. Also L.T. 1.5 v. A.D.35 at **1/4**.

RAMBLER MAINS UNIT—At last we are able to offer our special mains units kit for using our popular all-dry "Rambler" on A.C. Mains. Complete kit which when assembled, fits snugly into battery compartment, can be supplied at **47/6**, plus 1/6 packing and postage. Price includes all required components, and full assembly instructions.



THE "SUPERIOR FOUR" KIT. Our new four-valve receiver. A.C. mains, 200/250 v. M. and Long Waves. As with our very successful "Economy Four" all required components are supplied. Valve line-up: 2 S8G7, 6X5GT and 6V6GT. Chassis ready drilled. Cabinet size, 10½in. × 10in. wide. Maximum depth at base, 5in., tapering to 2½in. at top. Sloping front. Very attractively finished in light walnut and peach. Each component brand new and tested prior to packing. Complete Instruction booklet with practical and theoretical diagrams is provided. Booklet available at **1/6**, post free. Our price for complete kit, **£6/9/6**!!! Please add 2/6 packing and carriage. If preferred, we can supply Cabinet, Assembly only, comprising Cabinet and bracket wavechange switch, dial, pointer, drum pulleys, drive spindle, drive spring and knobs, at **45/-** plus 2/6 packing and carriage.

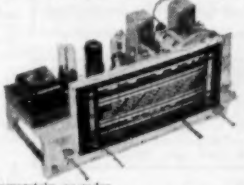
N.B.—Our Kits are even supplied with sufficient solder for the job!

THE R.C. GRAM REPLACEMENT CHASSIS KIT

To meet the very great demand for this type of receiver, we have produced this unit. For Long, Medium, and Short Waves. Valve line-up: 6K8 Frequency changer, 6K7, 1.F. Amplifier, 6Q7, 1st Audio, Detector and A.V.C., 6V6 Output, 6X5 Full-wave rectifier For A.C. mains 200/250 volts. 4 watts output. Excellent quality. High sensitivity Provision for gram. Attractive illuminated black, red, green and gold dial, for horizontal tuning. Four controls are: Tuning, L/M/S/Gram. Vol./on/off, Tone (variable). Chassis size: 13½in. × 5½in. × 2¼in. Dial size: 10in. × 4¼in. Assembly is simplified by the use of a 3-waveband coil pack, and pre-aligned 465 Kc/s. I.F. transformers—high-grade drop-through half-shrouded Mains Transformer, with voltage adjuster panel. This chassis can easily be assembled in one evening. Illustrated pamphlet with full assembley instructions, practical and theoretical wiring diagrams and itemized price list, **1/6**, post free.

The main items for this receiver can be supplied separately, as under.

Drilled chassis, complete with valve-holders, A/D panel, P/U panel, tuning condenser and ready-assembled dial and drive at **39/6**. 3 waveband coil pack with gram position, **39/6**, tax paid. Pair fo 465 Kc/s. I.F. Transformers, **9/6** pair. Half-shrouded drop-through Mains Transformer, **22/6**. The total cost of ALL items purchased separately is nearly £10, but we shall be pleased to supply all the required components right down to the last nut and bolt, at a special inclusive price of **£8/8/-**, plus 2/6 packing and postage. A set of four small brown or cream engraved knobs to suit is available at **1/2** each knob. This chassis is a professional job in every respect and can be seen and heard at our premises. This chassis can also be supplied, ready assembled, in very limited quantities, at **£9/19/6** plus 5/- carriage and packing.



THE "ECONOMY FOUR" T.R.F. KIT

A three valve plus metal rectifier receiver, A.C. mains 200/250 v. Medium and Long waves. We can supply all required components right down to the last nut and bolt. Valve line-up,6 K7, 6J7, and 6V6. Chassis ready drilled—Cabinet size 12in. long by 6in. high by 5in. deep—Choice of ivory or brown bakelite, or wooden, walnut finish cabinet. Complete instruction booklet with practical and theoretical diagram. Each component brand new and tested prior to packing. Our price **£5/10/-** complete—Remember this set is being demonstrated at our shop premises! We proudly claim that our fully illustrated instruction booklet is the most comprehensive available for this type of receiver—Booklet available at **1/6** post free—this is allowed if kit *is* purchased later—Please, 2/6 packing and carriage for complete kit.

THE R.E.P. ONE-VALVE BATTERY RECEIVER KIT. Simple one-valve all-dry battery receiver for headphones, easily built in one evening. All required components including headphones, can be supplied at inclusive cost of **42/-** plus 2/- p. & p. Operated by Ever Ready B114 type battery available at **7/9**. Full assembly details available separately at **9d.** plus 3d. post.

TELESCOPIC AERIAL MAST. Ex-R.A.F. dinghy transmitter mast. Total length when extended, 17ft. Collapses into two sections each approx. 24in. Complete with dies and lashings, lightweight duralumin construction, diameter at thickest point, 1¼ in. approx tapering to ¼in. New condition. **32/6**. Plus 2/- post and packing.

CO-AXIAL CABLE. Standard 80 ohms. brown, stranded centre conductor, **6d.** per yard only! Not Govt. surplus. Min. 12 yds. We stock **MICROPHONES** by Lustraphone, Ronette, etc and have available, ex-stock, the New ACOS Crystal Microphone Type MIC 35-1 at **25/-** and MIC 33-1 at **50/-**.

BRANDENBURG E.H.T. UNITS. 6-9 kV., **6 gns.**; 13-16 kV., **9 gns.**; 6-9 kV. coil, **39/-**; 10-15 kV. coil, **55/-**. Wiring diagram supplied.

SPECIAL ! ! !

DECCA LIGHTWEIGHT PICKUPS. Complete with either standard or L.P. Crystal Cartridge insets. Complete with Rest and Tracking instructions, **32/6** plus 2/6 P. & P. Also their very latest type, as above, but with turn-over head, **47/6** only!

TWO GANG .0005 mfd. Absolutely standard with feet by Wingrove & Rogers. Long spindle, **6/6** each. Ditto by J.B. but complete with built-in tirmmers, **8/6**.

THREE GANG DITTO, less mounting feet **6/6** only.

28 SET POWER UNIT NO. 4MK1 ZA10478—Complete with 4 metal rectifiers each 250 v. 60 mA. 2-12 v. 4 pin Mallery Vibrators transformer, condensers, resistors, signal lamp, indicator, etc., etc., in good condition. Complete in metal box size 10½in. × 6in. × 8in. Weight 19lb., **27/6**, plus 5/- P. & P.

VALVES. We have a very comprehensive stock of special purpose surplus valves at competitive prices. A stamp will bring Valve Price List.

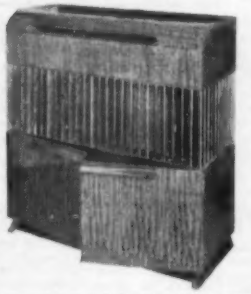
L.T. RECTIFIERS TYPE R.K. A newly manufactured range, guaranteed 12 months

6 or 12 v. 1 a. F.W. bridge type	7/6
6 or 12 v. 1.5 a.	9/6
6 or 12 v. 2 a. F.W. bridge type	11/3
6 or 12 v. 4 a. F.W. bridge type	15/-
6 or 12 v. 6 a. F.W. bridge type	23/6

CHARGER TRANSFORMERS. Input 230 v.

6/12 v. 2 a.	11/9
6/12 v. 4 a.	17/6
6/12 v. 6 a.	25/-

COIL PACKS. MANUFACTURERS SURPLUS. Few only, iron-cored, 7 waveband (2 medium, 5 short waves), comprising 14 coils, trimmers, wave-change, switch, etc. etc., complete with copy of manufacturers', original circuit, **50/-** only, tax paid. Completely assembled. Suitable Glass Dial **3/6**.



THE NEW R.C. HIGH-FIDELITY AMPLIFIER. P.P. 6V6 output. Freq. 25—18,000 cps.—60db at 6½ watts. Treble boost and cut—Bass boost—L.F. correction. Provision for Feeder Unit Max. UNDISTORTED OUTPUT 6½ watts. Price **14** gns., plus 7/6. **NOW AVAILABLE.** Kit of Parts, complete with fully illustrated instructions **£11/19/6**, plus 5/- carriage. Illustrated booklet available separately at **2/6**. Attractive metal cover, now available. With built-in carrying handle, **19/6**.

24 VOLT ROTARY CONVERTER. Input 24 v. D.C. Output 200/250 v. A.C. 100 watts. Complete in black steel box 18¼in. × 11¼in. × 8¼in. Weight approx. 30 lb. Completely smoothed, incorporates Sodium Lamp transformer. Brand new, **92/6**.

I.F. TRANSFORMERS. SPECIAL OFFER. All iron-cored 465 Kc/s. **Pilcey**—Iron-cored 2¼in. × 1¼in. × 1in., **7/6** pr. Philips, size 2¼in. × 1¼in. diameter (cylindrical), **7/6** pair. By Invicta—Cylindrical, 2¼in. × 1¼in. diameter, **9/6** pr. Also our own special ultra midget size, 1¼in. × 13/16in. × 13/16in. Only **9/9** per pair. By Wearite, Type 501 and 502 **12/6** per pair.

SPECIAL OFFER—Garrard AC/DC model "E" centre drive motor—for 78 r.p.m.—Speed regulator—Few only at **£7/19/6**, plus 2/6 packing and carriage. We also have in stock—Connoisseur 3-speed motors, pick-ups. Pick-ups and heads by Garrard, Decca, Collaro, Acos Chancery etc., etc., at current prices.

CABINETS. We can supply a cabinet for every requirement, Table Model, Extension Speaker, Portable Player, Console, even for Projection T/V! Why not call and see us?

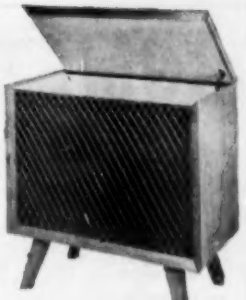
STUPENDOUS HALF-PRICE OFFER!!

DECCA 25A. Easily converted to either Standard or L.P. Price with one crystal cartridge of either type **£4/19/6**; or with both cartridges, **£5/19/6**. Plus 5/- P. & P.

POWER PACK TYPE 201. For 200/250 v. A.C. 50 cycle. Black case size 8¼in. × 6¼in. × 4¼in. Outputs 250 v. at 80 mA., 6.3 v. at 2.8 amps., 6.3 v. at .6 amp. (or 6X5), 31 v. at .3 amps. Could be adapted for R1155, etc. Price, complete, **27/6** only plus 2/6 P. & P. A Bargain.

AMPLIFIER BARGAIN. Super quality **push-pull** 4 valve 4 watt amplifier. Ideal for record or radio tuner reproduction. Measures only 7¼in. × 7¼in. × 3¼in. Valve line-up EL42, EL42, EZ41, EC83, for use with one or two 3-ohm speakers. Price **£7/7/-** plus 3/- P. & P.

"CONTEMPORARY." A well made Cabinet in light wood, made especially to blend with this type of furniture. The motor board is uncut, and will accommodate most Radio Chassis and Auto-change units. Size: 30in. × 15in. × 29in. high. Price **£3/15/-**, plus 10/- post and packing.



SPECIAL! Console Cabinet veneered Mahogany instantly recognisable as a product of Britain's most famous High-Fidelity Radiogram manufacturers. Original cost over £60.

At present intended for projection T/V, Amplifier and Feeder Unit, but easily adapted for Radiogram, Tape Recorder, etc. Ample space for record storage, etc. Our price **£18/18/-**, but we regret callers only, in view of strictly limited stocks.

RECEIVER TYPE 88/73. (TR1 receiver section of TR1196). Supplied complete with full data for conversion to 2-wave superhet receiver. Unit is complete with 6 valves 2-EF39, 2-EF36, EK32 and EBC33, also standard I.F.T's 465 Kc/s. Price **27/6** plus 2/6 P. & P.

TR1196 TRANSMITTER PORTION. We can also supply the transmitter portion of the above receiver incorporating valves, EL32, EF50, CV201. Type 600 relay, transformer, coils, switches, etc. Limited quantity at **12/6** only, plus 2/6 P. & P.

ELPICO 4-WATT AMPLIFIER. AC/34. A small 3-valve 3-stage audio amplifier, AC 200/250 v. Output 4 watts, 2/3 ohm. Suitable for Radio Microphone or Gramophone input. Volume and Tone Controls—Valve line up. 6SL7, 6V6, 5Z3—Engraved front panel. Size of chassis only—7in. × 5in. × 2in. Overall height—5½in. Price **£7/10/-**. We have in stock the very latest "**Elpico**" Feeder Unit type RF720. Superhet for L., M., Short and Trawler Bands. Very attractive illuminated black and gold dial, for immediate use with any amplifier. **15 gns.** tax paid.

PUBTABLE CABINETS. Manufacturers' surplus. Well made brown rexine covered. Will take any standard single player with bottom clearance of 3in. Total size closed 15in. × 13½in. × 5½in., fitted with snap catches and carrying handle. **22/6** only, plus 2/6 P. and P.

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SOMETHING FOR EVERYONE!

CONSTANT VOLTAGE TRANSFORMERS. Manufactured by SOLA of CHICAGO, U.S.A. Primary 90-125 v. or 190-250 v. Secondary 115 v. precisely at 2 KVA. Can be adjusted for 50 or 60 cycles operation. Primary and secondary are completely isolated, and for 230 v. output two can be used in series. Fully guaranteed. ONLY £21 each, or £40 per pair.

RF UNITS TYPE 26 and 27. For use with the R.1355 or any receiver with a 6.3 v. supply. These are the variable tuning units which use 2 valves EF54 and 1 of EC52. Type 26 covers 65-50 Mc/s (5-6 metres) and Type 27 covers 85-65 Mc/s (3.5-5.0 metres). Complete with valves, and BRAND NEW IN MAKER'S CARTONS. ONLY 35/- each.

I.F. STRIP 194. An easily modified strip recommended for T.V. constructors who want good results at moderate cost, or for those who have built televisors but are having trouble in the sound or vision receivers. Size 18in. x 5in. x 5in., it is complete with 6 valves VR65, 1 of VR92, and 1 of VR56 or VR53. Mod. data supplied. ONLY 45/- (postage etc., 2/6). Less valves, 19/6 (post etc., 2/6).

TELESCOPIC AERIAL. Pulls out of metal tube 15in. long to extend to 73in. BRAND NEW. ONLY 7/6 (postage 10d.).

AMPLIFIER 200. Ideal for conversion into a high gain TV pre-amp. Complete with 2 valves EF50. ONLY 15/- (postage, etc., 1/6).

INDICATOR TYPE 95. Built on a two-deck chassis, this contains VCR97 tube with mu-metal screen, 16 valves SP61, 4 of EA50, and 2 of EB34 and also shoals of components. ONLY 59/6 (carriage, etc., 7/6).

INDICATOR UNITS, TYPE 6. Contain VCR97 Tube with mu-metal screen, 4 valves EF50 and 2 of EB34. NEW CONDITION. ONLY 59/6 (carriage, etc., 7/6).

INDICATOR 233 CHASSIS. Similar to the type 6 Indicator Unit. This contains VCR97 CRT holder, 11 valve holders, resistors and condensors, etc. In excellent condition. ONLY 10/- (carriage, etc., 5/-).

AMERICAN 12v. DYNAMOTORS. Output 255 v. 60 mA. Ideal for car radio or running electric shaver from car battery. ONLY 22/6.

24 v. BLOWER MOTORS. ONLY 12/6.

C.R. TUBE VCR97. Tested full screen. BRAND NEW IN MAKER'S CRATES. ONLY 42/6.

6 v. VIBRATOR UNITS. Made by the National Co. of America for use with H.R.O. Communications Receivers, supplying 165 v. at 85 mA fully smoothed D.C. Complete with vibrator and 6X5 rectifier in black crackle cabinet size 7in. x 7½in. x 6in. only 29/6 (postage, etc., 2/6).

METAL RECTIFIERS. Selenium full wave bridge 6 or 12 volts; 1 amp. 7/6; 2 amp. 11/3; 3 amp. 12/6; 4 amp. 15/-;

COMMUNICATIONS RECEIVER R.1155

The famous ex-Bomber Command Receiver known the world over to be supreme in its class. Covers 5 wave ranges: 18.5-7.5 Mc/s, 7.5-3.0 Mc/s, 1,500-600 kc/s, 500-200 kc/s, 200-75 kc/s, and is easily and simply adapted for normal mains use, full details being supplied. Aerial tested before despatch. BRAND NEW AND UNUSED IN MAKER'S TRANSIT CASES, ONLY £11/19/6.
SLIGHTLY USED RECEIVERS, Grade 1, also tested working before despatch, £9/19/6.
A.C. MAINS POWER PACK OUTPUT STAGE, in black metal case, enabling the receiver to be operated immediately, by just plugging in, without any modification. Can be supplied as follows, WITH built-in 6½in. P.M. Speaker, £5/10/-, LESS speaker, £4/10/-.
DEDUCT 10/- IF PURCHASING RECEIVER AND POWER PACK TOGETHER.
Please add carriage cost of 10/6 for receiver and 5/- for Power pack.

POWER UNIT TYPE 3

Made for use with the R.1132.A, this is a standard rack mounting job to match the receiver, and is for 200/250 v. 50-cycle mains with outputs of 250 v. D.C. 100mA., and 6.3 v. 4 amps. Fitted with H.T. current meter and voltmeter, this is a first-class unit, and can be used for a variety of receivers. Used, but tested working before despatch. ONLY 90/- (carriage, etc., 5/-). Connecting Cable with Jones Plugs for receiver and power unit, 10/-.

CLASS D WAVEMETER

Another small quantity has become available since our "sell out" a few months ago, and intending purchasers should act quickly. This is a really first-class crystal controlled wavemeter, which has been repeatedly reviewed and recommended in the "R.S.G.B." Bulletin. Covers 1.9-8 m/cs., and is complete with 100/1,000 k/cs. crystal, 2 valves ARTH2, two 6-volt vibrators, and instruction manual. Designed for 6 v. D.C. operation, but modification data for A.C. supplied. UNUSED, IN MAKER'S TRANSIT CASES. ONLY £7/10/0. Transformer for A.C. modification, 7/6.

AMERICAN LORAN INDICATOR UNIT APN.4. The unit recommended as a basis for the "WIRELESS WORLD" TELEVISION OSCILLOSCOPE, copy of which is supplied, contains 5CP1 CRT and screen. 14 valves 6SN7, 3 of 6SL7, 8 of 6H6, 1 of 6SJ7, 100 kc/s crystal, and hundreds of condensers, resistors, etc., etc. BRAND NEW IN MAKER'S TRANSIT CASES. ONLY £6/19/6 (carr., etc., 15/6).

METERS

F.S.D.	SIZE AND TYPE		PRICE
1 milliamp	D.C.	2½ Flush square	15/-
1 "	D.C.	2½in. Flush circular	22/6
1 "	D.C.	2½in. Desk type	25/-
5 "	D.C.	2in. Flush square	7/6
100 "	D.C.	2½in. Flush circular	12/6
150 "	D.C.	2in. Flush square	7/6
500 "	D.C.	2½in. Flush circular	12/6
500 "	thermo	2in. Flush square	5/-
500 "	thermo	2in. Proj. circular	5/-
20 amps.	D.C.	2in. Proj. circular	7/6
40 amps.	D.C.	2in. Proj. circular	7/6
30-0-30 amps.	D.C.	Car type moving iron	5/-
15 volts	A.C.	2½in. Flush, circ., mov. iron	8/6

All meters Brand New in Maker's Cartons.

100 MICROAMPS METERS

2½in. circular flush mounting. Widely calibrated scale of 15 divisions marked "yards" which can be rewritten to suit requirements. These movements are almost unobtainable today and being BRAND NEW IN MAKER'S CARTONS are a snip at ONLY 42/6.

CRYSTALS. British Standard 2-pin 500 kc/s., 15/-. Miniature 200 k/cs. and 465 kc/s., 10/- each.

TR1196 TRANSMITTER SECTION. In perfect condition, less valves. ONLY 7/6 (postage, etc., 2/6).
159 RECEIVER UNIT. Contains 1 each valve, types EF50, EA50, SP61, RL37 and 24 v. selector switch. ONLY 12/6.

VACUUM PUMPS. For Handymen and Model Makers. Ex-R.A.F. Type B3. BRAND NEW IN MAKER'S CARTONS. ONLY 22/6 (post 2/-).

TRANSFORMERS. Manufactured to our specification and fully guaranteed. Upright mounting, fully shrouded, normal primaries.
425 v.-0-425 v. 250 mA., 6.3 v. 4 a., 6.3 v.4 a., 5 v., 3 a., 50/-.
350 v.-0-350 v. 160 mA., 6.3 v. 6 a., 6.3 v. 3 a., 5 v. 3a ., 42/6.
350 v.-0-350 v. 150 mA., 6.3 v. 5 a., 0-4-5 v. 3 a., 32/6.
250 v.-0-250 v. 100 mA., 6.3 v. 6 a., 5 v. 3 a., 32/6.
Please add 2/- per transformer postage.

TRANSFORMERS, FILAMENT. 6.3 v. 2 a., 7/6 (postage 1/-).

TRANSFORMERS, EHT. Upright mounting.
EHT for VCR97 Tube 2,500 v. 5 mA 2 v.-0-2 v. 1.1 a., 2 v.-0-2 v. 2 a., 37/6.
EHT 5,500 v. 5 mA., 2 v. 1 a., 72/6.
EHT 7,000 v. 5 mA., 2 v. 1 a., 82/6.
EHT 7,000 v. 5 mA., 4 v. 1 a., 82/6.
Please add 2/- per transformer postage.

RECEIVER TYPE 71. Covers 100-150 Mc/s., and contains 4 valves EF50, 2 of EF39, 1 of EL32 and 1 of EF36, together with a multitude of short-wave components. An excellent little breakdown unit for ONLY 25/- (post, etc., 2/6).

MU-METAL SCREEN FOR VCR97 TUBE, etc., ONLY 8/6.

CABLE. CLEARANCE OFFER of 23/36 twin polythene. Weatherproof, and suitable for outdoor use, 39/6 per 100 yard coil (carriage, etc., 3/6). S.A.E. for sample, trade enquiries invited.

SPECIAL OFFER. Ex Admiralty L.T. TRANSFORMER. Normal mains input, output 4 v. 20 amps. C.T. New and unused, these have become damaged, but are still usable, the damage being confined to broken fixing lugs, and/or broken bakelite terminal panels. Formerly sold at 30/-, now offered at 17/6 (post, etc., 2/6).

ROTARY POWER UNIT, Type 87. Ex-R.A.F. Input 24 v. Output 230 v. 65 mA., and 6.3 v. 2 amps. Fully filtered, smoothed, and noise suppressed. Ideal for running radio on boats or other 24 v. D.C. source. BRAND NEW. ONLY 15/- (postage, etc., 2/6).

INTERNATIONAL OCTAL PLUG. Fits into 1.O valveholder, 2/- (post 3d.).

GANGED POTENTIOMETERS. Double 50K and double 1 meg., 7/6 each.

CERAMIC 2-WAY 3-BANK SWITCHES, 7/6 each.

Cash with order please, and print name and address clearly

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of "MEDRESCO" DEAF AIDS

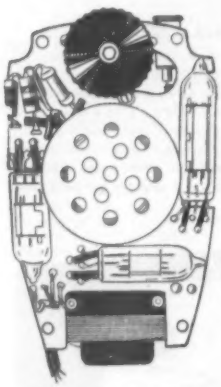
We have purchased from the Ministry of Supply 20,000 " Medresco " Deaf Aids type OL 10 as supplied by the Government under the National Health Act.

THE RADIO-MINDED AMATEUR will at once see the possibilities of converting this unit into many interesting devices such as :

MINIATURE RADIO RECEIVER—MODEL CONTROL EQUIPMENT — BABY ALARM — PRE-AMPLIFIER—INTERCOM TELEPHONE, etc., in addition to its original application.

WE HAVE DEVELOPED TWO INTERESTING CONVERSIONS

1. A Crystal Receiver incorporating a Germanium Diode, which may be built into the existing case (in place of the microphone). Loud headphone signals are thus obtainable in any area where the merest whisper is heard on an ordinary crystal receiver. This circuit requires no alteration to the wiring.



2. Alternatively we offer a circuit describing conversion of the first stage into a Detector with reaction. This converts the unit into an O-V-2 (detector with two stages of amplification) receiver which is capable of receiving transmissions within an area of many hundreds of miles. Conversion details are for medium waves only, however, conversion to long or short waves would present no difficulties to the technically minded. This circuit, however, involves fairly intricate wiring (in view of the miniature components used) and, although only a few connections are involved, we do not recommend this conversion except to those fairly competent with a soldering iron.

A miniature loudspeaker may be operated (at low volume levels) from either of the above circuits; for this we recommend a 45 V. HT supply. *The crystal microphone is, of course, not required for the above circuits.

QUANTITY ENQUIRIES welcomed from deaf aid Consultants, Stockists, and Exporters.

TECHNICAL DESCRIPTION

A three stage resistance coupled amplifier, two stages with CV 385 (U.S.A. equivalent CK 505) Pentodes and a CV 386 (U.S.A. equivalent CK 502) output Pentode. Total LT supply required is 1.5 V. at .06 mA total HT supply required is 80 V. at approximately 1.2 mA. A sensitive Crystal microphone is incorporated. The output circuit consists of a 60H choke with a feed back winding and a suitable condenser to isolate the HT current. A two position tone control switch is incorporated. A knurled knob (see case) gives finger-tip volume control. Case sizes: length 8½in. Width 2½in. Depth 1in. Battery leads and plugs are fitted.

WE OFFER the " Medresco " units in perfect working order (every one checked by experts) complete with Crystal Microphone and incorporating three Miniature Valves at the *remarkably low price of* **27/6** Postage 1/-.

* Price without Crystal Microphone 23/6. Post 1/-.

ACCESSORIES

Miniature crystal earpiece complete with lead and plug 6/6
Ever-Ready 1.5 V. LT battery (Type D 18) 8d.
Ever-Ready 90 V. HT battery (Type B 119) 4/3
Ever-Ready 45 V. HT battery (Type B 106) for greater gain and output ... 7/6

Conversion Accessories:

Set of parts for Crystal Receiver 5/-
Set of parts for O.V.2 Receiver 6/-
Circuits for above conversions, supplied Free.

STANDARD TELEPHONES cold cathode triodes type G24/20 **10/-**.
ERICSSON COUNTER VALVES (Decatrons) type G.C.10.A. **10/-**.
APN4 INDICATOR UNITS complete with 5CP1 tube but less valves and crystal. **35/-**. Crg. and pkg. 5/-. Send 10½d. for Wireless World " TV Oscilloscope Conversion " for above.
100 KC Crystals, as used in above, **17/6**.
IF TRANSFORMERS. Meissner F/M IFS. 4.3 Mc/s. **7/6** per pair. Military surplus 9.7 Mc/s. IFS., **3/-** each.
MOVING-COIL METERS. Centre-Zero. 2in. square, basic 750-0-750 microamps. (Originally air thermometer) **4/6**.
IRON-CLAD METERS. Moving iron, projecting 6in. scale. 300 V. 50 cycles, **37/6**. p.p. 2/-.
T.V. TRANSFORMERS. input 200/220/240 plus extra winding for RM4 or similar rectifier, 6.3 V. 4 A. 2 V. high insulation winding for C/R heater, **8/6**. p.p. 1/-.
TANNOY P.A. SPEAKERS. 8 watt 6in. diam. P.M. with re-entrant baffle mounted in wooden cabinet with line OP trans. Military surplus Cat. No. ZB11565, price **20/-**. Enquiries invited for quantities.
TEST SET TYPE 87. A super 150/300 Mc/s. signal generator, **£3**. Crg. and pkg. 10/-.
WOBBULATORS. Cossor type 343 ganging oscillator **£3/10/0**. Crg. and pkg. 10/-.
OUTPUT METERS made by Taylor. Type No. 4 Mk. 1 2.5Ω to 20 KΩ in ten stages. 25 milliwatt 50 microamps 6in. meter with five stage multiplier .01 to 100, **£8**.
PORTABLE TESTMETERS in wooden case 6½ x 6½ x 3½. 6in. scale length 150 V. D.C. (moving coil) basic 3 mA., **10/-**.
KLYSTRONS type 723A/B, **£4/10/0**. guaranteed.
MASTER COMPASS UNIT. Contains large quantity gears for the model maker and 4 counters. **25/-**. p.p. 2/-.
SMOOTHING CHOKES. 50Ω 4H at 300 mA 6H at 200 mA., **10/-**.
BLOCK CONDENSERS 8 mfd. 600 V.W. tropical. 750 V.W., normal, **5/-**.

Except where already stated please include 1/- for postage and packing under 20/-. Over 20/- free.

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SELENIUM METAL RECTIFIERS (S.T.C. TYPE). Built to specification from milliamps to amps., H/W., F/B., or three-phase. All work fully guaranteed. Very good delivery. Your enquiries invited for large or small quantities.

RECTIFIERS, PENCIL TYPES, S.T.C. K/3 SERIES. 1 milliamp for H.T. and E.H.T. APPLICATION, EX-STOCK.

Volts.	Type	Price	Volts	Type	Price	Volts	Type	Price
248	K3/10	3/10	1000	K3/40	7/6	2550	K3/100	14/8
375	K3/15	4/5	1140	K3/45	8/2	3080	K3/120	16/8
500	K3/20	5/1	1260	K3/50	8/8	3600	K3/140	19/3
655	K3/25	5/8	1500	K3/60	9/8	4100	K3/160	21/6
755	K3/30	6/-	1780	K3/70	11/-	4660	K3/180	24/3
885	K3/35	6/10	2030	K3/80	12/4	5150	K3/200	26/-

RECTIFIERS FOR L.T. APPLICATION—F.B. S.T.C. TYPE: 12 v. D.C. at 1 amp., 6/6; 12 v. D.C. at 2 amp., 10/6, 9d. p.p. 12 v. D.C. at 3 amp., 15/-, p.p. 1/-; 12 v. D.C. at 4 amp., 17/6; p.p. 1/3. 12 v. D.C. at 6 amp., 29/-, p.p. 2/-; 12 v. D.C. at 10 amp., 40/-, 2/6 p.p. 24 v. D.C. at 1 amp., 12/6; 24 v. D.C. at 2 amp., 21/-, p.p. 1/-; 24 v. D.C. at 4 amp., 30/-, p.p. 2/-; 24 v. D.C. at 6 amp., 35/-, p.p. 2/6.

VALVE TESTER, TYPE 4. 200/230 v. A.C. input. Ex-Govt., in good condition, with descriptive book containing circuit diagram of instrument and how to test valves from 1.4 v. to 40 v. With valveholders for Brit., 4, 5, 7 pin and Octal, U.S., 5 and 7 pin, 1/Octal, side contact, large Brit., 4 and 9 pin. Acorn and diode. Housed in substantial wooden case. Price £7/19/6, carriage 10/- extra.

WESTON ALL-PURPOSE A.C./D.C. TEST METER, MODEL E.665. 1,000 ohms per volt. New and unused, complete with leads and batteries. £8 each only, p.p. 3/6.

WESTON BATTERY OSCILLATOR, MODEL E.692. TYPE 2. Also new and unused. Coverage 100 kc/s-26 Mc/s. Audio output approx., 400 c/s. Available at the ridiculously low price of only £5/19/6, p.p. 4/6. (Oscillator complete with instruction booklet).

TELEPHONE L/SPEAKER No. 2 (By Vitavox). This is H/Duty 6" P.M. 15 ohm S/C. with 600 ohm built-in Link Transformer, housed in strong wooden case. £1.8.0. carriage 5/-.

VITAVOX PRESSURE UNITS. Heavy duty, P.M. 20 watts. To fit the above horn. Brand new. £4/9/6, carriage 5/-.

ROTARY CONVERTERS. 12 v. D.C. input 230 v. A.C. output, at 100 watts. Brand new. £4/17/6. Ditto, 24 v., same price, carriage 7/6.

AN/APA-1 CATHODE RAY INDICATOR AMPLIFIER UNIT. Complete, comprising OF. 3BP1 C.R.T., 7-6SN7GT, 1-6H6, 1-6G6, 1-2X2, 1-6X5, valves. Bargain value, £4/19/6, plus 10/- carriage.

TUNING UNITS (EX-U.S.A.). Types available, T.U.5B., T.U.6B., T.U.9B., T.U.26B. Good condition, soiled cases, 19/6 each, p.p. 3/-.

AC/DC SUPPLY UNIT. (S.T.C. SELENIUM RECTIFIER). Complete with Mains Isolation transformer, fixed and housed in strong metal cabinet, 250 v. A.C. to 200-220 v. D.C. @ 3-4 amps. Ready to use for £6/10/0 only, carriage 10/-.

METERS

0-1 m/a., 2½in. flush mounting round p.p. 1/6	21/-
0-1 amp., R.F. 2in. F/Mounting round	5/9
0-5 amp. D.C., 2in. F/Mounting. Square	9/6
0-50 amp. A.C. 6in. Surface Mounting. Round	30/-
0-300 v. A.C. 5in. F/Mounting. Round	45/-

CAR RADIO TRANSFORMERS. 12 v. ex-Philco, 300 v. H.T. at 90 mA. Brand new and unused. Only 12/6, p.p. 2/-.

TRANSFORMERS PUSH-PULL OUTPUT (BY PARMEKO) 25 watts for 6L6 valves. To match, 3, 8 and 15 ohms. New and unused. 29/6, p.p. 2/6.

R.1155 COMMUNICATION RECEIVERS. Individually tested and despatched in good working order. Cases slightly soiled. £8/19/6, carriage 10/-.

RECEIVER TYPE 109 in good condition. Freq. range 15-68 metres continuous, designed to operate on 6v. battery. Limited quantity only £4.7.6. plus 10/- carriage.

HALF MILE OF TWIN DON "8" TELEPHONE WIRE. Brand new, on wooden drums, £2/12/6 per drum, carriage 10/-. England only.

CAMERA CONTROL UNIT, TYPE 35. 24 v., 25/-, p.p. 2/6.

HIGH-VOLTAGE TRANSMITTING CONDENSERS. Hank Pot Type (25 pf. 8 kV) (400 pf. 9.6 kV.) (500 pf. 15 kV.) (600 pf. 9.6 kV.) (750 pf. 15 kV.). Any type, 3/6 each, p.p. 1/-.

CHROMIUM PLATED EXTENDIBLE AERIALS. Min. length 12in. Max. length 48in. Suitable for car radio aerials. 8/6 each. p.p. 9d.

CATHODE RAY TUBES.
Type 3BP1, new and unused, with base and screen, 42/6, p.p. 2/-.
Type VCR138 (ECR35). With screen and base, in new and unused condition, 42/6, p.p. 2/-.
Type VCR97, ex-Equip., in good order, 20/-, p.p. 3/6.
Type CV 1526, 2½in., 4 v. filament, 3,000 v. anode, complete with base and mu-metal screen, 20/-, p.p. 2/6.

PHOTO ELECTRIC MULTIPLIER CELLS. TYPE 931A. £3/10/-, p.p 1/-. Also 931A complete on chassis with multiplier network and two 832 valve-holders, etc., £3/10/-, p.p. 2/-.

POWER UNITS. Type 3, made for use with the R.1132A, this is a standard rack mounting job to match the receiver and is for 200/250 v. 50 cycle mains with output of 250 v. D.C., 100 mA. at 6.3 v. 4 amps. £3/10/-, carriage. Power unit for Wireless No. 11, 12 v. D.C. input, 230 v. D.C. output at 30 mA., fully smoothed, 19/6, 2/6 p.p. Power unit ex-No. 19 Trans-receiver, 12 v. D.C. input, 275 D.C. output at 100 mA., fully smoothed. 19/6, p.p. 4/-.

NO. 38 WALKIE-TALKIE TRANS-RECEIVER, in good condition (less external accessories), 35/-, p.p. 2/6.

SIEMENS HIGH SPEED RELAYS. Twin 1,000 ohm coils, perfect condition, 15/-, p.p. 6d.

2,000 OHMS H/R. EAR PIECES, 3/6 each, p.p. 9d.

MOVING COIL HEADPHONES. Brand new, 12/6 per pair, p.p. 1/-.

BATTERIES H.T./L.T. Heavy duty layer type. 150v. tapped at 87v. H.T. L.T. 4½v. Perfect condition. Size 9½in. x 4½in. x 4½in., 4/6, p.p. 2/6.

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(Opposite Granada Cinema)

COMPLETELY BUILT SIGNAL GENERATOR

Coverage 120 Kc/s-320 Kc/s., 300 Kc/s-900 Kc/s., 900 Kc/s.-2.75 Mc/s., 2.75 Mc/s.-8.5 Mc/s., 8.5 Mc/s.-25 Mc/s., 17 Mc/s.-50 Mc/s., 25.5 Mc/s.-75 Mc/s. Metal case 10 x 6½ x 4½in. Size of scale 6½ x 3½in., 2 valves and rectifier. A.C. mains 230-250 v. Internal modulation of 400 c.p.s. to a depth of 30 per cent., modulated or unmodulated, R.F. output continuously variable 100 milli volts. C.W. and mod. switch, variable A.F. output and moving coil output meter. Black crackle finished case and white panel. Accuracy plus or minus 2%. £4/19/6 or 34/- deposit and 3 monthly payments 25/- P. & P. 4/- extra.

PATTERN GENERATOR

40-70 Mc/s. direct calibration, checks frame and line time base, frequency and linearity, vision channel alignment, sound channel and sound rejection circuits and vision channel band width. Silver plated coils, black crackle finished case 10 x 6½ x 4½in. and white front panel. A.C. mains 200/250 volts. This instrument will align any T.V. receiver. Accuracy plus or minus 1%. Cash price £3/19/6 or 29/- deposit and 3 monthly payments of £1. P. & P. 4/- extra.

EXPORT & TRADE ENQUIRIES INVITED

(N.B. Post and packing charges stated apply to British Isles only.)

★ **Both generators guaranteed for 12 months** ★

MAINS TRANSFORMERS

Primary, 200-250 v. P. & P. 2/-.

300-0-300, 100 mA., 6 v. 3 amp. 5 v. 2 amp., **22/6**.

Drop thro' 350-0-350 v. 70 mA., 6 v. 2.5 amp., 5 v. 2 amp., **14/6**.

Drop thro' 250-0-250 v. 80 mA., 6 v. 3 amp., 5 v. 2 amp., **14/6**.

280-0-280, drop through, 80 mA., 6 v. 3 amp., 5 v. 2 amp., **14/6**.

253-0-253 80 mA., 6 v. 4 amp., **14/-**.

Drop thro' 280-0-280, 200 mA., 6 v. 3 amp., 5 v. 3 amp., **27/6**.

Drop thro' 270-0-270, 80 mA., 6 v. 3 amp., 4 v. 1.5 amp., **13/6**.

Drop thro' 270-0-270 60 mA., 6 v. 3 amp., **11/6**.

253 v. 350 mA., 6.3 v. 4 a., twice 2 v. 2 a. **19/6**.

Auto-trans. Input 200/250, H.T. 500 v. 250 mA., 6 v. 4 a., twice, 2 v. 2 a., **19/6**.

200-5-250, 60 mA., 6.3 v. 1.5 a. 0-5-6.3 v. 1.5 a., **10/6**.

Auto Trans. Input 200/250. H.T. 350 v. 350 mA Separate L.T. 6.3 v. 7 a., 6.3 v. 1½ amp., 5 v. 3 amp., **25/-**. P. & P. 3/-.

Heater Transformer. Pri. 230/250 v. 6 v. 1½ amp., **6/-**; 2 v. 2½ amp., **5/-**. **Pri. 200/250.** Secondary 9 v. 3.5 amp. 9 v. 3.5 amp., **12/6**.

Pri. 200/250. Secondary 9 v. 3.5 amp. 6.3 v. 3 amp., **12/6**.

Pri. 230 v. Sec. 500-0-500 and 500-0-500 250 mA. both windings. 4 v. 3 amp. 4 v. 3 amp. **39/6**. P. & P. 5/-.

Mains Transformer, fully impregnated. Input 210, 220, 230 and 240. Sec. 600-0-600, 275 mA., and 200 v. at 30 mA., complete with separate heater transformer. Input 210, 220, 230, 240. Sec. 6.3 v. 2 amp. three times, 0, 4, 6.3 v. at 3 amp. and 5 v. 3 amp., **45/-**. P. & P. 5/-.

Mains Transformer, fully impregnated. Input 210, 220, 230, 240. Sec. 350-0-350 100 mA., with separate heater transformer. Pri. 210, 220, 230, 240. Sec. 6.3 v. 2 amp., 6.3 v. 3 amp., 4 v. 6 amp., and 5 v. 2 amp., **30/-**. P. & P. 5/-.

MAINS TRANSFORMERS, chassis mounting, feet and voltage panel. Primaries 200/250.

350-0-350 75 mA. 6.3 v. 3 a. tap 4 v. 6.3 v. 1 a., **13/6**.

350-0-350 70 mA. 4 v. 4 a., 4 v. 2.5 a. C.T., **18/6**.

500-0-500 125 mA. 4 v. C.T. 4 a., 4 v. C.T. 4 a., 4 v. C.T. 2.5 a., **27/6**.

500-5-500 250 mA. 4 v. C.T. 5 a. 4 v. C.T. 5 a. 4 v. C.T. 4 a., **39/6**.

Set. T.V. Cabinet, front in contrasting walnut veneers, size 16½in. long, 11¼in. high, by 12¼in. wide. Complete with two pieces expanded aluminium in gold, 12 × 9in. and 5in. speaker baffle and chassis, **20/-**, post paid.

P.M. SPEAKERS

	with trans.	less trans.
2½in.	—	18/-
3½in.	—	16/-
5in.	19/-	15/-
6½in.	19/-	15/-
8in.	21/-	17/6
10in.	—	22/-

6½in. M.E. Speaker, 1,000 ohm field, **15/-**.

R. & A. T.V. energised 6½in. speaker with O.P. trans., field coil 175 ohms, **9/6**. P. & P. 2/6.

R. & A. 6½in. M.E. speaker with O.P. trans., field 440 ohms **10/6**. P. & P. 2/6.

Volume Controls. Long spindle less switch, 50K, 500K, 1 meg., **2/6** each. P. & P. 3d. each.

Volume Controls. Long spindle and switch, ¼, ½, 1 and 2 meg., **4/-** each; 10K and 50K, **3/6** each. ¼ and 1 meg., long spindle double pole switch, miniature, **5/-**. P. & P. 3d. each.

Trimmers, 5-40 pf., **5d.** 10-110, 10-250, 10-450 pf., **10d.**

Twin-gang .0005 Tuning Condenser, **5/-**. With trimmers, **7/6**.

Line Cord, 2-way 0.3 amp., 60 ohms per foot, **1/3** per yard.

Twin-Gang .0005, with feet, size 3½ × 2 × 1¼in., **6/6**.

3-gang .0005, with feet, size 4½ × 3 × 1¼in., **7/6**.

T.V. Coils, moulded former, iron-cored wound for re-winding purposes only. Ali-can 1½ × 1¼in., **1/-** each, 2 iron-core Ali-can 2½ × 1in., **1/6** each.

Used Metal Rectifier, 250 v. 150 mA. **6/6**.

Metal Rectifier. 230 v. 45 mA., **6/-**. **Metal Rectifier**. RM2, 125 v., 100 mA **3/6**.

D. COHEN

RADIO AND TELEVISION COMPONENTS

***Terms of Business:* Cash with order. Despatch of goods within 3 days from receipt of order. Where post and packing charge is not stated please add 1/6 up to 10/-, 2/- up to £1, and 2/6 up to £2. All enquiries, S.A.E., lists 5d. each.**

SPECIAL NOTE: NO GOODS SENT WHERE CUSTOMS DECLARATION IS APPLICABLE

23 HIGH STREET (Uxbridge Road) ACTON, W.3. Telephone: ACOrn 5901.

Hours of Business:

Saturday 9—5 p.m. Wednesday 9—1 p.m. Other days 9—6.30 p.m.

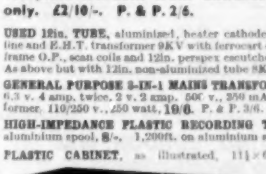
T.V. CONVERTER for the new commercial stations complete with 2 valves. Frequency:—can be set to any channel within the 186-196 Mc/s. band. I.F.:—will work into any existing T.V. receiver designed to work between 42-68 Mc/s. Sensitivity:—10 Mu/v with any normal T.V. set. Input:—arranged for 300 ohm feeder. 80 ohm feeder can be used with slight reduction in R.F. gain. Circuit EF80 as local oscillator. ECC81 as R.F. amplifier and mixer. The gain of the first stage, grounded grid R.F. AMPLIFIER 10 db. Required power supply of 200 v. D.C. at 25 mA. 6.3 v. A.C. at 0.6 amp. Input filter ensuring complete freedom from unwanted signals. 2 simple adjustments only. £2/10/-. P. & P. 2/6.

USED 12in. TUBE, aluminised, heater cathode-short, 10KV max. 2 v. heater complete with line and E.H.T. transformer 9KV with ferrocart core, line and width control; EY51 rec. winding frame O.P., scan coils and 12in. perspex escutcheon. **£6/17/6**. P. & P. 7/6.
As above but with 12in. non-aluminized tube 8KV max. **£5/17/6**. P. & P. 7/6.

GENERAL PURPOSE 3-IN-1 MAINS TRANSFORMER. Input 200/250. Sec. 250 v., 350 mA., 6.3 v. 4 amp. twice, 2 v. 2 amp. 500 v., 250 mA., 6.3 v. 4 amp. twice, 2 v. 2 amp. Auto-transformer. 110/250 v., 250 watt, **19/6**. P. & P. 3/6.

HIGH-IMPEDANCE PLASTIC RECORDING TAPE, by famous manufacturer. 600ft. on aluminium spool, **8/-**. 1,200ft. on aluminium spool, **17/6** post paid.

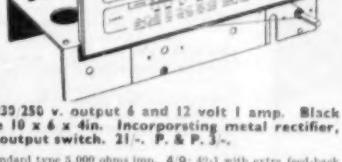
PLASTIC CABINET, as illustrated, 11½ × 6½ × 5½in., in Walnut, Cream and Green, also in polished Walnut complete with T.R.F. chassis, 2 wave-band scale, station names, new wave-band, back-plate, drum pointer, spring, drive spindle, 3 knobs and back, **22/6**. P. & P. 3/6.
AS ABOVE, with superhet chassis, **23/6**. P. & P. 3/6.
AS ABOVE, complete with new 5in. speaker to fit and O.P. trans., **27/6**. P. & P. 3/6. With superhet chassis, **28/6**. P. & P. 3/6.



Used metal rectifier, 250 v. 50 mA., **3/6**. gang with trimmers, **6/6**; M. & L. T.R.F. coils, **5/-**; 3 obsolete ex-Govt. valves 3 v/h and circuit, **4/6**; heater trans., **6/-**; volume control with switch, **3/6**; wave-change switch, **2/-**; 22 × 22 mfd., **4/-**; bias condenser, **1/-**; resistor kit, **2/-**; condenser kit, **4/-**; M. & L. Superhet Coils with circuits, **6/6**; iron-cored 465 I.F.s, **7/6**; mic. gang, **5/6**; volume control with switch, **4/-**; wave-change switch, **2/6**; heater trans., **7/6**; 4 v/h, **1/6**; 4 obsolete ex-Govt. valves, metal rectifier and Xtal diode with circuit, **14/6**; 25 × 25 mfd., **1/-**; 16 × 16 mfd., **3/3**; condenser kit (17), **7/6**; resistor kit (14), **3/6**.
Cyldon 5 channel T.V. Tuner, uses EF80 and 12AT7, less valves, **12/6**, post paid.
Radiogram Chassis, 5 valve A.C./D.C. 3 wave-band superhet 195-255 v., 19-49, 200-550 and 1,000-2,000 metres, I.F. 470 Kc. size of chassis 13 × 6½ × 2½in., size of scale 7½ × 3½in. valve line-up 10C1, 10F9, 10LD11, U404 and 10P14. Twin mains filter input, 2 dial lights and 5in. P.M. **£8/17/6**. P. & P. 5/-.

CR100 Coil packs, 10-2,000 metres, in soiled condition complete with 4-gang tuning condenser. 19/6. P. & P. 3/6.
CR100 Coil packs in first class condition less oscillator section, complete with 4-gang tuning condenser. 19/6. P. & P. 3/6.
CR100 465 Kc. I.F.s, types 3, 4 and 5 and B.F.O., new condition, 7/6 each
465 Kc Xtal for CR100, 12/6.
4-gang tuning condenser for CR100, 9/6

CONSTRUCTOR'S PARCEL comprising chassis 12½ × 8 × 2½in., cad. plated, 18 gauge, v/h., I.F. and trans. cut-outs, back-plate, 2 supporting brackets, 3 wave-band scale, new wavelength stations names. Size of scale 11½ × 4½in., drive sp., drum, 2 pulleys, pointer, 2 bulb holders, 5 pax. I.O. v/h., 4 knobs and pair of 465 I.F.s, twin gang 16 × 16 mfd. 350 wkg., mains trans. 250-0-250 60 mA., 6.3 v., 2 amp., 5 v. 2 amp. and 6½in. M.E. speaker with O.P. trans. **39/6**. P. & P. 3/6.



Battery charger, input 235 250 v. output 6 and 12 volt 1 amp. Black crackle finished case size 10 x 6 x 4in. Incorporating metal rectifier, mains on-off switch, and output switch. 21/-. P. & P. 3/-.

OUTPUT TRANSFORMERS. Standard type 5,000 ohms imp., **4/9**; 42-1 with extra feed-back windings, **4/3**. Miniature 42-1, **3/3**. Multi-ratio 3,500, 7,000 and 14,000, **5/6**. 10-watt push-pull 6V6 matching, **7/-**. 90-1 3 ohm speech coil, **6/6**.

PUSH-BACK CONNECTING WIRE. Doz. yds., **1/6**. Post paid.

STANDARD WAVE-CHANGE SWITCHES 4-pole 3-way, **1/9**; 5-pole 3-way, **1/9**; 3-pole 3-way, **1/9**; 9-pole 3-way, **3/6**; Miniature type, long spindle 3-pole 4-way, 4-pole 3-way and 4-pole 2-way, **2/6** each. 2-pole 11-way twin wafer **5/-**; 1-pole 12-way single wafer **5/-**. P. & P. 3d.

POTATO AND VEGETABLE PEELER

By famous manufacturer. To suit models A200 and A700. Capacity 4½lbs., complete with water pump. All aluminium construction, white stove-enamelled finish. Originally intended for adaption on an electric food-mixer, can be easily converted for hand operation. 39/6. P. & P. 3/-.

PERSONAL SHOPPERS ONLY. 9in. Enlarger, **17/6**; 12in., **27/6**.

Germanium Crystal Diode, **1/6**, post paid.

Used 9in. Tube, with ion burn, **17/6**. post paid.

Line O.P. Transformer in aluminium can mounted in rubber, **12/6**.

Crystal Set, medium and long wave, in plastic cabinet, **16/-**.

Headphones, per pair **8/-**.

Speaker Matching Unit on aluminium chassis, 3-15 ohms, reversible, **12/6**.

Line and E.H.T. Transformer, 14 Kv. using ferrocart core, complete with line and width control, and corona shields U37 rectifier winding, **35/-**.

Line and E.H.T. Transformer, 9 Kv., using ferrocart core, complete with built-in line and width control. Mounted on small ali-chassis. Overall size 4½ × 1½in. EY51 rec. winding, **27/6**.

Line and E.H.T. Transformer, 9 Kv., ferrocart core, EY51 heater winding, complete with scan coils and frame output transformer, and line and width control, **22/5/-**. P. & P. 5/-.

Scan Coils, low line low impedance frame, complete with frame transformer, to match above, **27/6**. P. & P. 2/-.

Valve Holders, moulded octal Mazda and loctal, **7d.** each. Paxolin, octal Mazda and loctal, **4d.** each. Moulded B7G, B8A and B9A, **7d.** each. B7G moulded with screening can, **1/6** each.

32 mfd., 350 wkg.	2/-
16 × 24, 350 wkg.	4/-
4 mfd., 200 wkg.	1/3
40 mfd., 400 wkg.	2/6
16 × 8 mfd., 500 wkg.	4/6
16 × 16 mfd., 500 wkg.	5/9
16 × 16 mfd., 450 wkg.	3/9
32 × 32 mfd., 350 wkg.	4/-
32 × 32 mfd., 350 wkg., and 25 mfd., 25 wkg.	6/6
25 mfd., 25 wkg.	1/6
250 mfd., 12 v. wkg.	1/-
16 mfd., 500 wkg., wire ends	3/3
8 mfd., 500 v. wkg., wire ends	2/6
8 mfd., 350 v. wkg., tag ends	1/6
50 mfd., 25 v. wkg., wire ends	1/9
100 mfd., 350 wkg.	4/-
100 mfd., 450 v. wkg., 280 mA. A.C. ripple	3/11
150 mfd., 350 v. wkg., 280 mA. A.C. ripple	4/6
100 + 200 mfd., 350 wkg.	9/6
16 + 16 mfd., 350 wkg.	3/3
50 mfd., 180 wkg.	1/9
65 mfd., 220 wkg.	1/6
8 mfd., 150 wkg.	1/6
60 + 100 mfd., 280 wkg.	7/6
50 mfd., 12 wkg.	1/6
32 + 32 mfd. min. 275 wkg.	4/-
50 mfd., 50 wkg.	1/9

Miniature wire ends moulded 100 pf., 500 pf., and .001 ea... **7d.**

T.V. Filter in lightly tinted Perspex size 13½ × 11 × 3/16in **4/6**.

Combined 12in. mask and escutcheon in lightly tinted Perspex. New aspect edged in brown. Fits on front of cabinet, **12/6**. As above for 15in. tube. **17/6**.

Frame Oscillator Blocking Trans., 4/6. Line Osc. Blocking Trans., 4/6.

Tube Mounting Bracket, size 9½ × 4½in. 12in. tube clamps, **2/-**.

CHOKES:
2-20 Hen., 150 mA., **15/-**. P. & P. 3/-.
6 Hen., 275 mA., **15/-**. P. & P. 3/-.
100 Hen., 40 mA., **15/-**. P. & P. 3/-.
2 henry 150 mA. **3/6**; 250 mA. 10 henry **10/6**; 5 henry 250 mA. 60 ohms **8/6**.

P.M. Focus Unit for any 9 or 12in. tube except Mazda 12in., with Vernier adjustment, **15/-**.

P.M. Focus Unit for Mazda, 12in., with vernier adjustment, **17/6**.

Wide Angle P.M. Focus Units, Vernier adj. state tube, **25/-**.

Energised Focus Coil, low resistance mounting bracket, **17/6**.

Ion Traps for Mullard or English Electric tubes, **5/-**, post paid.

465 Kc. I.F.s, size 2½ × 1¼in. Q.110, removed from American equipment **5/-** per pair. Standard 465 Kc. iron-cored I.F.s, 4 × 1½ × 1¼in., per pr. **7/6**. We write standard, iron-cored, 465 Kc. I.F.s 3½ × 1½ × 1¼in., per pr. **9/6**.

Iron-cored 465 Kc. Whistle Filter, **2/6**.
465 KC. MIDGET I.F.s. Q.120 size 1¼in. long, 1in. wide, 1in. deep by very famous manufacturer. Pre-aligned adjustable iron-dust cores, per pair **12/6**.

Mains Droppers. 0.3 amp., 460 ohms, tapped 280 and 410, **1/6**; 0.2 amp. 717 ohms, tapped at 100 ohms, vitreous, **1/6**; 0.3 amps, 950 ohms, tapped 700 and 825, **2/6**; 0.2 amp., 1,000 ohms, vitreous, tapped, **2/6**; vitreous, 0.3 amp., 700, tapped 580, 640, 800, **3/6**. P. & P. on each 3d.

T.V. Width Controls, 3/6.

SAMSON'S SURPLUS STORES

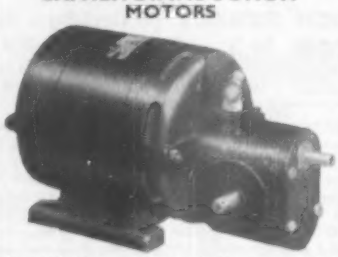
LONDON'S GREATEST DEALERS IN RADIO AND ELECTRONIC EQUIPMENT

SPECIAL OFFER OF S.T.C. RECTIFIER SUPPLY UNITS. Supplied brand new at a fraction of the maker's price. **No. 1.** A.C. input 200-240 v. Output D.C. 50 v. 24 amps. With ammeter fuses and control switching. Built in grey metal case measuring 2ft. 6in. x 1ft. 7in., **£27/10/-**, plus carr. **No. 2.** A.C. input 200-240 v. D.C. output 50-60 v. 10 amps. with ammeter fuses, control switching, built in grey metal case measuring 1ft. 10in. x 1ft. 3in. x 10½in., **£22/10/-**, plus carr. **No. 3.** A.C. input 200-250 v. D.C. output 220 v., 1.5 amps. at 50 degrees C. Completely fused, **£15**, plus carr. **No. 4.** A.C. input 100-250 v. D.C. output tapped 12-24 v. 3 amps. continuously rated. Completely shrouded in metal case with fuses-switch and output sockets. Cases slightly soiled, **£4/10/-**, carr. 5/-.

HEAVY DUTY A.M. L.T. TRANSFORMERS. Pri. 440 v. Sec. 220 v., in steps of 25 v. conservatively rated at 2.2. kW., weight approx. 90 lb. Half the above secondary can be obtained from 220 v. input, **£9/10/-**, plus carr. Pri. 230 v. Sec. 50 v. 20 amps., completely enclosed, **£6/10/-**, plus carr. Pri. 230 v. Sec. 13, 13.5, 14, 15 v., very conservatively rated at 60 amps., **£6/5/-**, plus carr. Pri. 115 v. Sec. 17 v. 15 amps. and 2.2 v. 18 amps., **35/-**, carr. 4/-. Pri. 230 v. Sec. 8.2 C.T., very conservatively rated at 10 amps., **25/-**, carr. 2/6. Pri. 200-250 v. Sec. 115 v. 8.7 amps., **£3/15/-**, carr. 5/-.

A.M. H.T. TRANSFORMERS. Pri. 230 v. Sec. 1,500 v. 1.6 kVA, **65/-**, carr. 7/6.

CROYDON ENG. CO., GEARED CAPACITOR/INDUCTION MOTORS



A.C. 220-240 v. Motor shaft 1,400 r.p.m. Geared right angle shaft 300 r.p.m. Continuously rated. With Capacitor, **£3/19/6**, carr. 5/-.

1154 TX H.T. TRANSFORMERS. Pri. 200-250 v. Sec. 1250-1300 v. 350 mA, **35/-**, carr. 4/-.

CONSTANT VOLTAGE TRANSFORMERS BY SOLA, U.S.A. Pri. 90-125 v. or 190-250 v. Sec. 115 v. at 2 kVA. Pri. and Sec. are completely isolated for 50 or 60 cycle operation. Approx. weight 200 lb., **£19/10/-** each, **£37/10/-** per pair, carriage according to distance, limited supply only.

HEAVY DUTY SLIDING RESISTORS. ALL by famous makers offered at a fraction of the original price. 5.3 ohm 8 amp., with geared control, **35/-**. 152 ohm 2 amp., with geared control, **32/6**. 20 ohm 7 to 1.5 amp., with right angle geared drive, **37/6**. 0.4 ohm 25 amp., **22/6**. P. & P. on all types, 2/-.

ROLLS-ROYCE COOLANT PUMPS. A heavy duty Turbine type pump driven directly from a splined socket 1,000-1,500 G.P.H. 1¼in. bore outlet. Brand new in maker's carton, **45/-**, carr. 2/6.

ARMY FIELD TELEPHONES TYPE D3. Buzzer calling. Complete with hand set and batteries. Built in strong metal cases. Suitable for farms, building sites, workshops, etc., **49/6** ea., carr. 3/-.

ADMIRALTY SOUND POWERED HAND SETS, no batteries required, **17/6**, P.P. 1/6. **TELEPHONE CABLE.** Single D3, one-mile drums, **55/-**, carr. 5/-.

COMMANDO ASSAULT TELEPHONE CABLE, P.V.C. 1,000-yard drums, ideal telephone cable and very useful for the home and garden, **15/-** per drum, P.P. 1/6.

12in. COPPER PLATED AERIAL RODS. Push-in sleeve joint, **8/6** per half gross, **15/-** per gross, P.P. 1/6. SPECIAL PRICE of **£2** per thousand in ten thousand lots, plus carr.

ALL ORDERS & ENQUIRIES TO OUR EDGWARE ROAD BRANCH PLEASE. THIS IS OPEN ALL DAY SATURDAY. HOURS 9-6 9-1 THURSDAY.

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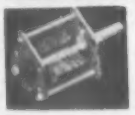
PERSONAL SHOPPERS WELCOME.
ORDERS ACCEPTED M/A FROM COLLEGES, SCHOOLS, LABORATORIES, ETC.

LARGE QUANTITIES GUARANTEED UNUSED COMPONENTS STILL AVAILABLE

1,000 CERAMIC VARIABLE CONDENSERS, split stator, plated vanes, spaced .025 ball bearings butterfly 15/15 P.F. extended spindle. .....EA. **2/6**

2,500 CERAMIC TRIMMERS, air spaced silver-plated vanes, 22 pF. Packed in 10's and singles, screwdriver adjustment .....DOZ. **5/-**



2,500 VARIABLE CONDENSERS, 100 pF. ceramic insulation .....EA. **2/-**

2,000 VARIABLE CONDENSERS. 50pF., in screening case, 3½ × 1½ × 2½. Spacing .040in. **1/-**

TRANSMITTER TANK CONDENSERS, split stator 250 pF. each section. Heavily silver-plated vanes rounded and polished, air gap .096, sealed cartons EA. **10/6**
U.K. post 2/6.

200 VOLTAGE REGULATORS, V8.110/30 mA., 4-pin base **3/6**

1,000 30-AMP. 1-WAY DOUBLE POLE Changeover Switches on ¼in. Ebonite Base, ex Admiralty EA. **9d.**

10,000 TAXLEY TYPE 1-pole 6-way Switches, complete, less screws, with knobs. .....EA. **6d.**

1,500 WAVE CHANGE, 2-wafer 6-pole 3-way Switches ..... EA. **1/3**

10,000 ERIE RESISTORS, 6W, 2-watts, boxed in 50's and 5's. **ERIE RESISTORS,** 1,200 ohm, ½ watt. Boxed in 50's. 150K 1 watt, 22K 1 watt, 70K 1 watt; price 2 watts, **3d.**; 1 watt, **2d.**; ½ watt, 1d.
Wire-wound Vitreous 10-watt wire ends, 500Ω ..... **9d.**

5,000 STAND-OFF INSULATORS only miniature 1 inch .....DOZ. **2/-**

1,000 POTS 100K, ¼ spindle ..... EA. **1/-**

500 POTS, 1 meg. ..... EA. **1/-**

1,000 POTS, 2 gang each, 70K ..... EA. **1/-**

1,000 HUMDINGER POTS, 100 ohm. Miniature wire wound ..... EA. **2/-**

1,000 POTS COLVERN, 200 ohms 5 watts. Wire wound, N.P. case ..... EA. **2/-**

1,000 WIRE WOUND POTS, 2,000 ohm 5 watts, E. case ..... EA. **1/6**

250 100K MINIATURE POTS ..... EA. **1/-**

7,500 VALVEHOLDERS B9G, Paxolin. DOZ. **4/-**

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PERMANOID SLEEVING. 1500v. test in coils of 1 gross yds., **8/6** per coil.

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MODULATOR TYPE 67. This unit is a pulse modulator with pulse width of 1, 2 and 5 micro-seconds. The pulse amplitude is also variable. It is a particularly useful instrument as it contains a heavy duty power pack suitable for 230 volt 50 cps. mains supply. The mains transformer outputs are 6.3 volts twice, 5 volts, for the rectifier and the H.T. winding is 345-0-345 volts. Also included are 5 SP61, one VR116, 2 EB34, and 3 EA50. Size of case 18 × 9 × 7 inches. These units are brand new in original packing cases. Price 67/6 plus 7/6 carriage.

POWER PACK TYPE 301. This was the mains power pack used for the complete TR.1196 contained in a neat black case size 8½in. × 4½in. × 6½in. high. For 200/250 volts A.C. 50 cps. Output 250-0-250 v. 6.3 at 2.8 amps. 6.3 v. at .6 amps. for 6X5G rectifier. 31 volts at .3 amps. supplies metal rectifier for bias. The transformer is a massive job. Price only 37/6 plus 2/6 post. Should be O.K. for R.1155, etc.

METER BARGAINS, ALL BRAND NEW

15 v. (50 ~) mov. iron 2½in. pnl. mtg....	8/6
20 volt moving coil 2in. sq. pnl. mtg. ...	7/6
3,500 volts moving coil 3½in. projection	10/-
150 milli-amp. 2in. sq. pnl. mtg.....	7/6
5 milli-amp. moving coil 2in. sq. pnl. mtg.	7/6
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100 micro-amps. 2½in. barrel pnl. mtg. scaled 0-1,500 in 15 clear divisions. Only	42/6
500mA. Thermo Couple 2in. sq. pnl. mtg.	5/-

METER RECTIFIERS. 1 mA. Salford instruments, 8/9. 5mA. Salford Instruments, 6/9. 2mA. S.T.C. as used in E.M.I. Output Meter, 5/6. All are full wave bridge and brand new.

METAL RECTIFIERS. Heavy duty Selenium 10½in. long with 3½in. square plates. Two are required for a full wave bridge giving 48 volts at 10 amps. Brand new and ridiculously cheap at only 57/6 per pair plus 2/6 post. R.M.4 250 volts 250-mA. Only 12/6. R.M.2, 4/3 each or 2 for 8/-. Selenium 300 volts 100 mA. Brand new, ex-W.D., 6/9 each.

X'TALS

465 kc/s S.T.C. ½in. pins suitable for crystal gates, IF checking, etc. Brand new, boxed, 10/- each.
200 kc/s American G.E.C. ½in. pins suitable for crystal calibrators, etc. Brand new, boxed, 10/- each.

6 VOLT H.R.O. VIBRATOR PACK. Gives 165 volts at 80 mA. smoothed D.C. Uses Mallory Vibrator 6X5G, heavy duty smoothing choke, etc. In black crackle cabinet size 7in. × 7in. × 6in. Brand new, only 29/6.

POWER UNIT TYPE 285. A.C. mains input 230 v. 50 cps. Outputs E.H.T. 2 kV. @ 5 mA., H.T. 450 volts @ 200 mA., L.T. 6.3 v. @ 17 amps., fully smoothed, 2 chokes, paper condensers, etc., complete with valves 5U4G, VU 120 and EF 50. This was the ground power unit for the "Gee" equipment and should be very useful for T.V., etc. A REAL BARGAIN AT ONLY 69/6.

TRANSFORMER BARGAINS. Brand new ex-manufacturer's surplus drop through. Primary 200/250 volts 50 cps. Secondary 310-0-310 v. 70 mA., 6.3 @ 3 a., 4 v. @ 2 a. Can be used with either 4 v. or 6.3 v. rectifier. Only 9/6 plus 1/6 post. A similar type transformer 325-0-325 100 mA., 6.3 v. 4 a., etc., can be supplied to callers only at 14/6.
Filament transformers, standard tapped primary, 12 v. 1½ a. and 4 v. 1½ a. secondary. Only 7/6.

GRAYSHAW INSTRUMENTS

We are London stockists of these fine instruments which represent superlative value. We can thoroughly recommend these and have no hesitation in stating that they compare very favourably with much more expensive equipment.
Now available—**SIGNAL GENERATOR SG50** covering 100 Kc/s to 80 Mc/s on FUNDAMENTALS in 6 bands. Priced at £7/19/6, its handsome appearance does not belie its excellent performance.
RESISTANCE CAPACITY BRIDGES priced at £6/19/6. An accurate and compact companion instrument also available.

COMMUNICATIONS RECEIVER ADMIRALTY TYPE B.28 (MARCONI CR.100). Valve line up 2 RF, F.C. separate local Osc., 3 I.F.'s, 2nd Det., Output, B.F.O., and rectifier. Self contained power supply 200/250 volts A.C. 50 cps. Variable Selectivity (crystal filter), 6,000, 3,000, 1,200, 300 and 100 cycles. Frequency coverage 60 kc/s to 30 Mc/s in six ranges, continuous except for gap between 420 to 500 kc/s. Size 16in. × 13½in. × 12in. Weight 82lb. The set for the serious operator. Thoroughly overhauled and in good condition, complete with new valves and air tested prior to despatch. A real bargain at only £27/10/- plus £1 carriage.

RECEIVER 25/73 (TR.1196). This is a six-valve superhet receiver with 465 kc/s I.F.s. Complete with all valves—2 EF39, 1 EK32, 2 EF36, 1 EBC33. In good condition with full conversion data. Price 27/6 plus 2/6 postage.

COMMUNICATIONS RECEIVER TYPE R.1155. For world-wide reception. We ARE ONCE AGAIN ABLE TO OFFER THESE FINE RECEIVERS ABSOLUTELY BRAND NEW IN ORIGINAL TRANSIT CASE AT £11/19/6 plus 10/6 carriage. This delivery is in really fine condition. If you are contemplating the purchase of one of these receivers in the near future, we advise you not to delay in order to secure a really "MINT" receiver.

SLIGHTLY USED MODELS STILL AVAILABLE. Price £7/19/6 plus 10/6 carriage. All receivers gladly demonstrated to callers and air tested prior to despatch. Send 1/3 for full details and circuit, which is supplied free with each receiver.

A.C. MAINS POWER PACK OUTPUT STAGE. Enable the R.1155 to be used to operate speaker from 200/250 volts A.C. without ANY MODIFICATION WHATEVER. All our power packs have heavy duty transformers, are complete with leads and Jones plugs and are guaranteed for 6 months.
Type A. In smart black metal case, size 8½in. × 4½in. × 6½in., less speaker, price £4/10/- plus 3/6 carriage.
Type B. With built in 5in. speaker in black metal case size 13½in. × 5½in. × 7½in. Price £5/5/- plus 3/6 carriage.
Type C. With an 8in. speaker in specially designed beautiful black crackle cabinet speaker to match receiver, size 11½in. × 10½in. × 6in. A de Luxe job. Price £6/10/- plus 3/6 carriage.

NOTE: 10/- REDUCTION WHEN PURCHASING ANY OF THE ABOVE POWER PACKS WITH RECEIVER.

TRANSMITTER TYPE 12. Frequency coverage 1.2 to 17.5 Mc/s in four bands. M.O., Buffer, P.A., 2 stage Modulator, built in stabilised A.C. mains power pack, P.A. Anode current meter M.C.W., C.W., and R.T. operation. Can be crystal controlled. Super "Table Topper" size 24in. × 12½in. × 17½in. weight 134lb. Complete with all valves ready for operation. In first-class condition and tested before despatch, with circuit and full instructions. Only £16/16/- plus 14/- carriage. Can be demonstrated to callers.

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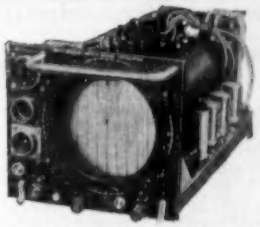
HEAVY DUTY SLIDING RESISTORS. 250 watts rated to carry 25 amps., resistance 0.4 ohms, suitable for physics labs, charging board, etc. Laboratory type with worm drive, on metal stand, size 9in. × 4in. × 6in. high. Price 7/6 each. BRAND NEW.



INDICATOR TYPE 182A

Indicator contains 3 EF50, 1 SU4G, 4 SP61 and a 6½in. C.R.T. Type VCR 517, complete with Mu Metal-screen, 9 wire wound pots, with large assortment of resistors and condensers. Can be converted to Oscilloscope (as described in "Radio Constructor"). Circuit supplied. Tubes have no "Cut Off" and can be demonstrated to callers. BRAND NEW (less relays). In original transit case, 67/6 plus 7/6 carriage.

INDICATOR UNIT TYPE 95. Exactly the same as the 62 indicator unit but is 50 cycle version. Double decker chassis, containing loads of components, 16 SP61, 2 EB34, 4 EA50, etc., etc. Brand new condition (less VCR97). Only 45/- plus 7/6 carriage.

U.S.A. DYNAMOTOR

12 volts D.C. input, 250 volts 60 mA. output, weight 2½lb., size 4½in. × 3in. diameter. Ideal for car radio, mobile amplifiers, small transmitters, etc. All tested prior to despatch. Only 22/6 post paid.

45 Mc/s PYE STRIP. Vision unit for London frequency complete with 6 EF50 and EA50. Circuit provided. Ex-brand new units. Price £3/10/-.

E.H.T. TRANSFORMER. For VCR97, etc. Mains input, output 2,500 volts, 4 volts at 2 amps. and 2-0-2 volts at 2 amps. Fully guaranteed at 35/- plus 1/- post.

NITROGOL CONDENSERS. With ceramic insulating terminals. 8 mfd. 2 kV. wkg. size 5 in. × 3½in. × 4½in., at 12/6 each. 4 mf. 2 kV wkg. size 3½in. × 2½in. × 4½in. at 7/6 each. 4 mf. 1.25 kV. wkg. size 3½in. × 2½in. × 4½in. at 5/6 each.
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U.S.A. BLOWER MOTOR for 105 volts A.C. operation. Outlet 2½in. diameter, extremely powerful. Snip for only 22/6 plus 2/- post.

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50 Mfd. 12 v., 1/- each ... 10/6
12 Mfd. 50 v. Tubular Paper (aluminium tubes), 1/- each ... 10/6
100 Mfd. 6 v. Tubular Paper (aluminium tubes), 1/- each ... 10/6
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MIDGET MICA CONDENSERS: .0001, .0002, .0003, .0004, .0005, 4/-.
200 Assorted Moulded Micas. Popular Values ... £2 10 0
200 Assorted Silver Micas. Popular Values ... £2 10 0
200 Assorted Carbon Resistors: ½, ¼ and 1 watt. Good selection ... £1 10 0

CARBON RESISTORS: ¼ watt 2/6; ½ w. 3/-; 1 w. 4/-; 2 w. 6/- per doz.

HIGH STABILITY RESISTORS:

Tolerance:	1%	2%	5%
¼ watt	1/-	9d.	6d. each
½ watt	1/3	1/-	9d. each
1 watt	1/9	1/6	1/3 each

C.O.D. preferred for resistor orders as we cannot guarantee to stock all values.

PYE PLUGS AND SOCKETS ... 1/6 pair
8-40 MEG 2 watt ... 2/6 each

WW AND VITREOUS RESISTORS. 5 watt, 1/6: 10 watt, 2/6; 15 watt, 3/-; 20/30 watt, 3/6 each

WW V/CONTROLS. COLVERN and B-NSF. 5K PRESET and other values, 2-3 watt, 2/- each. 10K Isolated Spindle ... 2/-
500 ohms, 1K, 20K, 25K, 50K, with spindle ... 3/-

V CONTROLS WITH SWITCH: most values, B-NSF ... 2/6

V/CONTROLS: Less Switch, Preset and Spindle. MOST VALUES ... 1/9

TWIN MIDGET GANGS, .0005, with trimmers, PERSPEX COVER ... 5/6

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ASSORTED PILOT LAMP HOLDERS ... 4/- ,,

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POINTER KNOBS. Small black, with line, ¼in. hole ... 7/6 ,,

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PHILIPS TRIMMER TOOLS ... 1/- each

BELLING & LEE. P/M FUSE HOLDERS. Type L356 ... 2/6 ,,

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VALVE HOLDERS: Moulded. B9A, 7/6; B7G, 6/-; EF50, Pax., 6/-; EF50, Ceramic, 9/- per doz.; **ENGLISH OCTAL,** 3/- per doz. **SCREEN CANS** for B9A, B7G, 6/- doz.; **PAXOLIN**—B7G, MAZDA 4-pin UX ... 3/- ,,
Valveholders fitted with lower screens to accommodate cans, 1/6 per doz. extra.

BELLING & LEE PLUGS AND SOCKETS. Ex-Govt. BRAND NEW. 5-pin, 1/6; 7-pin, 1/9; 10-pin ... 2/6 pair

BULGIN. P74, Plug and Socket, 2/6; P200, Plug and Socket, 2/-; Rotary Switches, S.255, 2/-; Dolly Switches, S.267, 2/-; Standard Switches, Ex-Govt., On-off ... 1/6 each

POST OFFICE LAMP JACKS, No. 10, 1/- each ... 9/- doz.
Lamp Covers for same ... 3/- ,,

L.F. CHOKES, 300 w., 60 mA. CH5 ... 4/6 each

OUTPUT TRANSFORMERS. Multi Ratio, 5/-; Pentode or Power ... 4/- ,,

VALVE SCREEN CANS for Standard Valves, 1/- each ... 10/6 doz.

DRUM DRIVES, 4½in. ... 1/- each

WESTECTORS. WX6, WX12, W1, W12, W4, 1/- each ... 9/- doz.

ARCOLECTRIC (Whitney Lamp), Red, green, clear, 1/6 each ... 15/- ,,

SIGNAL LAMP HOLDERS P.M, complete with adjusting lamp holders, 1/9 each ... 18/- ,,

AIR SPACE TRIMMERS. Preset and spindle types, 5PL, 10PF, 15PF, 20PF, 25PF, 50PF, 75PF, 15/-; 100PF Preset, 1/6 each ... 15/- ,,

JONES PLUG AND SOCKETS. 4-pin, 2/6; 6-pin, 3/-; 8-pin, 3/6; 10-pin, 4/-; 12-pin ... 6/- pair

NUTS, 8BA, 3/-; 6BA, 2/6; 4BA, 3/-; 2BA ... 4/- gross

SOLDER TAGS, 2/6 gross. **SHAKEPROOF WASHERS** ... 2/- ,,

WASHERS, 2, 4 and 6BA ... 1/- ,,

SHAKEPROOF SOLDER TAGS, 4BA and 6BA, 2/6; 2BA ... 2/9 ,,

CASH WITH ORDER OR C.O.D. **ALL ORDERS DEPT. W.1**

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T.V. POWER TRANS. By Parmeko. Pri. 200/250 v. EHT 6 kV. (RMS) 350/350 v. 250 ma., 6.3 v. 6 a., 4 v. 3 a., 4 v. for EHT Rec. Wired to Holder. Beautiful job. £4/10/-, carr. paid. FEW ONLY.

METERS. 2½in. Flush mounting M.C. 100 mA., 0-10 mA., 0-30mA., 12/6 ea.; 0-15 A., proj. thermo. 2½in., 7/6; 0-9 A. hot-wire, 5/-.

TEST METER. 7 ranges as follows: 1.5 v., 3 v., 150 v. 6 mA., 60 mA., 5,000 ohms, 25,000 ohms 2½in. dia. scale M.C. meter. Rotary selector switch. Black bakelite case, 6 x 4½ x 4½ fitted with removable lid, also provision for internal batts., ranges can be easily extended. Bargain price 30/-, plus 1/6 post.

SPECIAL OFFER, AR88 SPARES. Cabinets, complete with base, feet and side strips, £4/15/- each. Pkg. and Carr. 5/-. **Set** of 14 valves for "D" or "LF" model receivers, £5/10/-. **Panel** escutcheons, 22/6 each. "D" type I.F.S., 12/6 each. Good selection of **Spare Coils** available for "D" **Model,** 7/6 each. **Output Transformers** for "D" or "LF," 37/6 each.

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COPPER WIRE. 14G H.D. 140ft. 15/-, 70ft. 7/6, postage and packing 2/-. Other lengths pro rata.

SPECIAL VALVE OFFER. 866A, 17/6 each, or 30/- pair. 807's, 10/- each or 17/6 pr. 931 A, 45/-. 829B, 60/-. TZ40 35/-. 813's 80/-.

STREAMLINED BUG KEYS. By famous manufacturer. List over £4. Our price 45/-. **AIR SPACED COAXIAL CABLE,** 150 ohm (normal price 3/11 per ft.), 20 yd. coils only. £1 per coil, post free.

SHADED POLE MOTORS. For Tape Recorders, etc. Voltage tapping plate 200/250 v. 3-hole fixing. Our price 12/6 ea. or 21/- pr., P. & P. 1/6 either.

Carriage paid on all orders over £1 except where stated. Please include small amount for orders under £1.

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RCA TRANSMITTERS Type **ET-4336.** Complete with original speech amplifier, crystal multiplier and VFO units. Unused and re-conditioned. Can be supplied with very large quantity of spares.

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MULTI CHANNEL TRANSMITTER T-4/FRC, with modulators MD-1/FRC, 2 Mc/s to 18 Mc/s. Each channel 400 w. output.

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SCR536 (BC611) in excellent condition.

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TX VALVES 805, 807, 813, 861, 66A, 100TH, 250TH, and many others.

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All Components as per Denco's list, also 5 valves (6AM6, 12AH8, EB91 and 2 6AB4) at £6/7/6 or built and aligned at £8/10/-.

All parts obtainable singly as per Denco's F.M. Catalogue (D.T.B. 8). Price 1/6

Requires 230 v. at 50 m/a. 6.3 v. at 1.5 amps.

Demonstrations daily. Alignment 7/6.

TR1196 RECEIVER

Receiver 25/7/6. This is a six-valve superhet receiver with 465 kc/s I.F.'s. Complete with all valves—2 EF39, 1 EK32, 2 EF36, 1 EB34. In brand new condition with full conversion data. **27/6**, plus 2/6 post and pkg.

6 WATT AMPLIFIER (UNDISTORTED

Manufactured by Parmeko and Sound Sales for Admiralty. 4 valves, PX25, M8/PEN, AC/HL, MU14. Output Matching and 3Ω and 15Ω. 100/250 v. A.C. COMPLETE IN STEEL GREY AMPLIFIER CASE. **£9/10/-.** Call for Demonstration.

STROBE UNITS. Brand New, in sealed cartons, these contain 6EF50s, 5EA50s, 1SP61, a host of condensers, resistors, transformers, chokes, relays, switches, 7 pots, and 5 smoothing condensers, size 18in. × 8½in. × 7½in. Only **67/6.**

RCA 931A PHOTO-ELECTRIC CELL AND MULTIPLIER. For facsimile transmission, flying spot teleeine transmission and research involving low light-levels, 9-stage multiplier. Brand new and guaranteed, only **£9/10/-.** Special 11-pin base 8/-. Data sheets supplied.

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3 Wave-band Superhet. Med., long and short.

5 Latest Type MULLARD Valves.

4 Position Switching. Gram., med., long and short.

Provision for Extension Speaker. A.C. Mains. 110/250 volts.

Chassis 11in. x 7in. x 2½in. Scale 8in. Square. Or Chassis 13½in. x 6½in. x 2½in. Dial 10in. x 5½in. PRICE **£10/5/-.**

BRAND NEW AND GUARANTEED. CARR., PACKING AND INS. 10/-.

SPECIAL OFFER

Our Tape-Deck Amplifier and Power Unit (List £16/16/-) and TRUVOX Tape-Deck Mark III (List £23/2/-). **£36.** Call for Demonstration or send for full details.

PYE 45 Mc/s. STRIP TYPE 3583 UNITS

Size 15in. × 8in. × 2in. Complete with 45 Mc/s. Pye Strip, 12 valves 10 EF50, EB34 and EA50, volume controls and hosts of Resistors and Condensers. Sound and vision can be incorporated on this chassis with minimum space. New condition. Modification data supplied. Price **25.** Carriage paid.

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6 v.	M.C.	2½in.	Projection	10/-
15 v. (50 c.)	M.I.	2½in.	Flush	10/-
20 v.	M.C.	2in.	Square	7/6
150 v.	M.C.	2½in.	Flush	10/-
300 v.	M.C.	2in.	Square	12/6
300 v.	A.C.	Projection	3in. Dial	50/-

AMP-METERS

1 A.	M.C.	2½in.	Projection	10/-
3 A.	T.-C.	2in.	Square	6/-
6 A.	T.-C.	2½in.	Flush	7/6
15 A.	M.I.	4in.	Projection	21/-
20 A.	M.I.	2½in.	Flush Mtg.	12/6
30 A.	M.C.	2in.	Square	7/6

MILLIAMMETERS

500 uA.	M.C.	2in.	Round	15/-
1 mA.	M.C.	2½in.	Flush	29/6
1 mA.	M.C.	2½in.	Desk Type	25/-
5 mA.	M.C.	2in.	Square	7/6
10 mA.	M.C.	2½in.	Flush	10/-
30 mA.	M.C.	2in.	Round	7/6
30 mA.	M.C.	2½in.	Flush	10/-
50 mA.	M.C.	2in.	Square	7/6
150 mA.	M.C.	2in.	Square	7/6
200 mA.	M.C.	2½in.	Flush	10/-
300 mA.	M.C.	2½in.	Round	10/-
500 mA.	M.C.	2½in.	Flush	10/-
G.E.C.	1 mA.	Meter	Rect.	10/-

M.C. = Moving Coil. M.I. = Moving Iron.

T.-C. = Thermo-Coupled.

All Meters are Brand New and in original cartons.

No. 38 "WALKIE-TALKIE" TRANSRECEIVER, complete with Throat Mike, phones, Junction Box and Aerial Rods in canvas bag. Freq. range 7.4 to 9 Mc/s. Range approx. 5 miles. All units are as new and tested before despatch. **£4/10/-.**

"426" CONTROL UNIT

Containing 4 EF50, 2 SP61, 2 EA50, 1 EB34, 2-single-gang .0005 tuning condensers. W/W volume/controls, switches, condensers and resistors. Size 12in. x 9in. x 5in. New condition, **35/-**, carr. 3/-.

BOWTHORPE CONTINUITY METER

Dual scale 0-500 ohms and 100-200,000 ohms moving coil operated from 4½-volt internal battery. Size 6in. × 3in. × 4in.

Original price, **£8/19/-.**

Our price, brand new, **£3/5/-.**

T.C.C. .1 mfd. 5/7,000 v. wkg., type CP58QO, Bakelite case, **7/6** each.

INDICATOR UNIT TYPE 182A

Unit contains VCR517 Cathode Ray 6in. tube, complete with Mu-metal screen, 3 EF50, 4 SP61 and 1 5U4G valves, 9 wire-wound volume controls and quantity of resistors and condensers. Suitable either for basis of television (full picture guaranteed) or Oscilloscope. Offered BRAND NEW (less relay) in original packing cases at **67/6.** Plus 7/6 carr. "Radio-Constructor" 'scope circuit included.

ROTARY POWER UNIT TYPE "87"

Input 24 v. Output 220 volts 75 mA. and 6.3 volts 2 amps. Fully filtered and smoothed and noise suppressed. Ideal for car radio, etc. BRAND NEW, ONLY **15/-** (postage, etc., 2/6).

G.E.C. RECORDING TAPE

600ft. Reels..... 10/-

1,200ft. Reels..... 17/6

BUY NOW—UNREPEATABLE BARGAIN.

EF50 (VR91A)

The selected EF50, Red Sylvania, original boxes **10/-** each, **90/-** for ten

MORSE PRACTICE KIT

Complete with buzzer, morse tutor and battery compartment on baseboard, 6/-, post paid.

CRYSTALS

200 kc/s, 2 pin, U.S.A.	10/-
465 kc/s, 2 pin, U.S.A.	10/-
500 kc/s, 2 pin, British	15/-

METRO-VIC (METROSIL) PENCIL TYPE E.H.T. REGULATOR up to 10 k.v.

Particularly suitable for regulating E.H.T. Fly-back. 5/-.

TUNING CONDENSERS

.0003 Midget 2½ × 1½ × 1¼in.	5/-
.0005 Midget 2½ × 1½ × 1¼in., with trimmers	6/6
.0005 Standard Size, with trimmers	7/6
.0005 with 4-way push-button assembly	7/6

NEON INDICATOR LAMP

Siemens type VI122. Diameter 1½ × ¾in. Strik'ng volts 80 v. S.P.B.C. 2/6 post free.

EXTRA SPECIAL VALUE IN MIDGET TYPE ELECTROLYTICS

Metal tubular wire ends with cardboard sleeves

8 mfd., 450 v.	2/-
16 mfd., 450 v.	3/-
8 × 8 mfd., 450 v.	3/6
16 × 8 mfd., 450 v.	4/6
16 × 8 mfd., 350 v.	3/6
32 × 32 mfd., 450 v., 3 × 1¼in.	6/-
16 × 16 mfd., 450 v., 3 × 1¼in.	5/-
60 × 40 mfd., 350 v., 4½ × 1in.	5/-
B.I. 8 m54., 500 v., block, 3 × 1¼in.	2/-

R.F. UNITS

Type 24

20-30 Mc/s.

Switched Tuning.

With 3-SP61

15/- EACH

BRAND NEW

Type 25

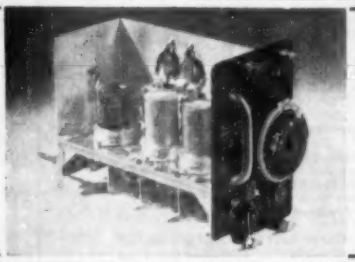
40-50 Mc/s.

Switched Tuning.

With 3-SP61

19/6 EACH

BRAND NEW



R.F. UNITS

Type 26

50-65 Mc/s.

Variable Tuning.

2—VR136. 1—VR137

35/- EACH

BRAND NEW

Type 27

60-80 Mc/s.

Variable Tuning.

2—VR136. 1—VR137

35/- EACH

BRAND NEW

T.V. PRE-AMPLIFIER FOR LONDON AND BIRMINGHAM. Complete with 6AM6. Ready to plug into your set, **27/6.** P. P. 2/6.

CRYSTAL MICROPHONE INSERTS

8/6 POST FREE

8/6 POST FREE

Ideal for tape recording and amplifiers. No matching transformer required.

CATHODE RAY TUBES

VCR139A. 2½in. C/R Tube. Brand new in original cartons (carr. free)	£1 15 0
VCR97. Guaranteed full T/V picture (carr. 2/-)	£2 0 0
VCR517C. Guaranteed full T/V picture	£1 15 0
MU-METAL SCREENS for VCR97 or 517. P.P. 1/6	10 0
9in. ENLARGER for VCR97 or 517. P.P. 1/6	17 6

VCR97. 15/-, carr. 2/-. Brand new and crated—slight cut-off—ideal for 'Scopes. Limited quantity.

PHOTO CELLS G.S.18. Brand new, 25/-.

PLEASE ADD POSTAGE. ARTICLES UP TO 10/-, 1/-. £1, 1/6. £2, 2/-.

Prices slashed at Clydesdale

PLEASE NOTE. Carriage and Postal charges refer to the U.K. only. Overseas freight, etc., extra.

T1154B TRANSMITTER UNIT. Medium/High powered for C.W.-M.C.W. R/T 3 ranges, 10-5.5 mcs. 5.5-3 mcs. 500-200 kcs. Complete with 4 valves, etc., in metal case 14in. x 16½in. x 8½in. External Power Supply required.
ASK FOR E5A. **39/6** each. CARRIAGE 7/6
Circuit 2/3

VISUAL INDICATOR TYPE I. Ref. 100/2. Dual reading left/right D.F. meter for R1155, 2½in. Scale overall. Dim.: 3½in. x 2½in., in used condition.
ASK FOR H862A. **12/6** each. POST PAID

S.440-B V.H.F. TRANSMITTER CHASSIS. Part of the Stratton P40 Equipment. Partly stripped by the M.O.S., less valves, inductances and Crystal, but otherwise a good basis for reconstruction, compact size 14in. x 8in. x 7in. Original frequencies 85-95 Mc/s.
ASK FOR H817. **15/-** each. CARRIAGE PAID
Circuit 1/3

WS-18 RECEIVER CHASSIS. Complete with valves, 3/ARP12 (VP23) AR8 (HL23DD), I.F. 465 kcs. Range 6-9 mcs. (battery operated). Chassis 8½in. x 5in. x 1in. Front panel 9½in. x 5½in.
ASK FOR H22. **25/-** each. POST PAID
Circuit and Data 2/3.

RECEIVER UNIT TYPE 25. Ref.: 10P/1L. Part of TR1196 Range 4.3-6.7 mcs. with valves 2/VR53 (EF39), 2VR56 (EF36), VR55 (EBC33), VR57 (EK32), 21.F.T. 460 kcs. etc., in metal case 8½in. x 6½in. x 6½in.
ASK FOR H299. **25/-** each. POST AND PACKING 3/6 extra.
Circuit and Data 1/6

RECEIVER UNIT R.3601. Ref. ODB/6037. With valves: 2/VR136 (EF54), VR137 (EC52), 5/VR65 (SP61), 4/VR92 (EA50), VR91 (EF50), 6V6G, VU39A (R3), etc., IF.13 mcs. Dim.: 18in. x 9in. x 8in. Wgt. 38 lbs.
ASK FOR H493. **39/6** each. CARRIAGE PAID
Circuit 1/3

R.F. UNIT TYPE 24. In Original Carton. With valves 3-VR65 (SP61) etc. Range 20-30 mc/s., switched tuning. Dim.: 9½in. x 7½in. x 4½in. Wgt. 7 lbs.
ASK FOR H850. **10/-** each. POST 1/6 EXTRA
Circuit 1/3

R.F. UNIT TYPE 25. In Original Carton. Range 40-50 mcs., otherwise as R.F.24.
ASK FOR H874. **12/6** each. POST 1/6 EXTRA
Circuit 1/3

R.F. UNIT TYPE 27. WITH BROKEN DIAL. Range 65-85 mc/s. valves 2-VR135 (EF54), VR137 (EC52), etc. Dim.: and Wgt. as R.F.24. Variable Tuning.
ASK FOR E771. **39/6** each. POST 1/6 EXTRA
Circuit 1/3

SUPPRESSOR UNIT SC/870. Contains 4 H.F. chokes and 4 tubular condensers 0.1 mfd. 250 v. D.C., carrying 5 amps. (2 sets on each led), each choke and condenser separately screened in compartments of aluminium alloy box 4½in. x 4in. x 2in., 4 hole fixing.
ASK FOR H907. **2/6** each. POST 1/- EXTRA

WIRELESS REMOTE CONTROL UNIT D-No. 2 Mk. 2. ZA.20491. Wooden box 7½in. x 6½in. x 5½in., with hinged lid, containing 3 relays, 1 make, 500 ohms, 1 make 20 ohms, and H.D. double coil type 1,750 ohms, coil makes, 200 ohms, coil breaks, plus QMB switch and 8 brass terminals.
ASK FOR H803. **7/11** each. POST PAID

5 WAY GROUPBOARDS. Paxolin panel 2½in. x 2½in., with tags for mounting 5 condensers or resistors, two hole fixing.
ASK FOR H981. **6d.** each. POST 3d.
Or 3 for 1/6 post paid.

CO-AXIAL CABLE. Any length supplied 52 ohms, 12 mm. dia., price 5d. per yard. Minimum 12 yards at 5/- post paid. Ask for E987.

THROAT MICROPHONE. Ref.: ZA.13935. Pair Electro Magnetic lozenge shaped pieces (7.5 ohms) with strap, lead and jackplug.
ASK FOR E14. **3/11** each. POST 6d. EXTRA

THROAT MICROPHONE. Ref. : ZA.19734. Pair Electro Magnetic lozenge shaped pieces (7.5 ohms) with strap, lead and jackplug.
ASK FOR H955 **4/11** each. POST 6d. EXTRA

THROAT MICROPHONE. (U.S.A made.) Pair Carbon buttons on mtd. rubber with strap, lead and miniature 2 pin plug.
ASK FOR H57 **3/11** each. POST 6d. EXTRA

MICROPHONE. Ref.: 10A/14381. (Flying Helmet Type.) Electro Magnetic 50 ohms with switch, lead and 2 way socket.
ASK FOR E16 **3/11** each. POST 6d. EXTRA

CARBON HANDSET MICROPHONE No. 4A.
ASK FOR E13 **7/6** each. POST PAID

Order direct from :— *Phone : South 2706/9.*

CLYDESDALE SUPPLY CO. LTD. 2, BRIDGE STREET, GLASGOW · C.5

RHEOSTATS. 12 v. 1A 2/6. 12 v. 5A 10/6
MORSE KEYS. Bakelite fully enclosed, 3/6.
BENDIX SELSYN TRANSMITTER MOTORS, TYPE VIII A.C. 50 v. 50 cycle, 4in. x 3½in. new. 27/6.
NEW FREQUENCY CRYSTALS. 9100 and 4500 kc., 10/6 4860-4800-2400-594-561-560H559 Kc. 6/6. ½in. spacе pins.
SETS OF 6. CARBON TWIST DRILLS. 1/16in. to ¼in. or ⅛in. to ½in. 3/6 set.
PLESSEY T.V. PRE-AMPLIFIER. London band. Valve 6F13. Complete, 25/6.
VALVES Lists supplied.
CYLDON 5-CHANNEL PRE-TUNER. Gives 26 D.B. gain. Fit one of these to your T.V. for better pictures. I.F. Output 9.5-14 Mc/s., 15.5-22 Mc/s. With valves EF80, ECC81, 52/6. Less valves, 15/-.
MAINS TRANSFORMERS. Input 200/240 v. Output 350-0-350 or 250-0-250 volt 80 mA., and 4 and 6.3 v. 4 a. and 4 and 5 v. 2 a. Price 21/6. Input 200/240 v. Output tapped 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 20, 24, 30 volts, 2 amp., 21/6. Output 17-11-5 volts 5 amp., 22/6. Output 17-11-5 volts 1½ amp., 16/6. 6.3 v. 2½ a., 8/6. All with one year's guarantee.
D.P.D.T. RELAYS. Operate at 200/300 volts D.C. 8/6. We can supply any type of voltage and contacts at varying prices.
NEW SELENIUM RECTIFIERS. F.W. 12/6 volt 3 amps., 14/6; 4 amp., 22/6; 6 amp., 30/-; 1 amp., 8/6; 12 v. 100 mA., 3/-; 24 v. 2 amp., 30/-; H.W., 250 v. 100 mA., 9/-; 250 v. 275 mA., 17/6; 250 v. 60 mA., 6/6.
GERMANIUM or SILICON CRYSTAL DIODES, 3/9
M/C MICROPHONES with matched Trans., 15/6.
FL8 FILTER UNITS, 8/6. Same as FL8 but less switch.
TR1196 TRANSMITTER SECTION. New and complete but less valves. 4.6-6.8 Mc/s. Easily converted, 15/- With valves TT11, EL32, EF50, £2.
L.R. ARMY HEADPHONES, 9/6.
TIME DELAY RELAYS We specialise in units giving varying time constants. Please send us your requirements or problems.
FISHING ROD AERIALS. Set 3—12ft., 7/6.
RUBBER MOUNTING BASES, 3/6.
P.O. VEEDER COUNTERS 0-9999, 24/50 volts D.C., 15/6.
All Carriage paid in the U.K. from Dept. W.W.
U.S. ARMY F.M. TRANSMITTER TYPE 604D, complete with 80 crystals, 20-28 M/cs., and F.M. Receiver Type 603D, £30.

AR88LF in tip-top condition, £55.
U.S. ARMY FIELD TELEPHONES. TYPE EE8, £3/10/- each. Carriage extra on above items.

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MIDLAND INSTRUMENT CO.

PLESSEY P.M. SPEAKERS, 3in. dia., personal portable type, 2-ohm speech coil, less transformer, brand new, 7/6, post 9d.
CHARGING KITS, consists of a G.E.C. 1½-amp. full-wave rectifier, and a Douglas 200/250-v. A.C. input transformer, specially wound for this rectifier, with requisite voltages to charge a 2, 6 or 12-v. battery at 1½-amps., 2 high grade components, complete with circuit diagrams and instructions, brand new, 25/-, post 1/6.
G.E.C. MINIATURE RELAYS, all contacts are platinum, and relays are brand new boxed, 5,000-ohms, 2-pole change-over, hermetically sealed, 10/-, post 6d. Ditto, 5,000-ohms, 2-pole change-over and 2-pole make before break, hermetically sealed, 12/6, post 6d. Ditto, 40-ohms, 4-pole change-over, open type, 8/-, post 6d.
G.E.C. TYPE 600 RELAYS, brand new and boxed, 75-ohm, 2-pole heavy-duty make and 1-pole change-over, 5/-, post 6d. Ditto, 150-ohms, 2-pole heavy-duty make, 5/-, post 6d. Ditto, 5,000-ohms, 1-pole make and 1-pole make before break, 7/6, post 6d. Ditto, 7,800-ohms, 1-pole make, 6/-, post 6d.
U.S. RELAYS, 1,each pattern, 200-ohm, 2-pole changeover, 1/6, post 4d., 15/- doz., post 1/8, ditto 2-pole changeover, 1/9, post 4d., 18/- doz., post 2/-.
BUZZERS, 3-6-v. high note, platinum contacts, variable note control knob, high grade type, worth 40/-, our price, new unused, 5/-, post 1/-.
VENNER TIME DELAY SWITCHES, 24-v. operation, consists of a high grade clockwork movement, with external press button wind, 2 electro magnets with 5-pole cam operated contacts, in smart metal case size 3½in. x 2½in. x 2½in., fitted 4-way terminal block, new, boxed, fraction of original cost, 7/6, post 1/3.
ELECTROLYTIC CONDENSERS, 32-mfd. 450-v. D.C., by Zenith, Micamold, etc., new and guaranteed, cartons of 25 condensers, 80/-, post paid.
PROJECTION UNITS, consists of an optical mount, fitted with a bloomed f/2.2 Achromatic lens, 3½in. focal length, at one end, also a convex/concave ground glass at the other, attached to an enclosed lamphouse, fitted with a 24-v. 15-watt lamp, and polished reflector, fraction of original cost, 10/-, post 1/-.
VARIABLE RHEOSTATS, wire-wound on ceramic, 50-ohms at 1-amp., laminated wiper arm, Bakelite knob control, in diecast cases size 5½in. x 4½in. x 3½in., fitted on/off toggle switch and 2 cannon plugs, new, boxed, 7/6, post 1/6.
SELSYN TRANSMITTERS (Magslips), 3in. type, pure synchro x-y-1-2-3, suitable as master or slave, 50-v. 50-cycle single phase A.C. operated. When two or more of these are wired up, the rotation by hand (or other means) of one, will result in a 100 per cent. follow in the other(s), both clockwise or anti-clockwise, supplied brand new with test report, in tropicalised sealed cartons. Value, £8 each, our price 25/-, post 2/-, 2 for 50/-, post paid with wiring diagram. **SIEMEN'S HIGH SPEED RELAYS** coil res. 145 ohms, single-pole changeover platinum contacts, adjustable armature tension and contact gap, well worth 35/-, our price, new, unused, 5/-, post 6d., 50/- doz., post 2/-.
TELEPHONE SETS, consists of 2 combined receivers and microphones, connected by 20ft. twin flexible, provides perfect 2-way communication (up to 1 mile with extra flex), self-energised, no battery required, complete ready for use, new, boxed, 12/6, post 1/-.
CRYSTAL SET COILS, high-gain dual range med. and low, complete with crystal set circuit, 2/6, post 4d.; Variable conds. .0005 mfd., Bakelite dielectric, complete with pointer knob, 3/6, post 4d.; Germanium detector, latest wire-ended type, 2/-, post 3d.; Wavechange switches, 6d., post 3d.; Clix plugs with sockets, 4 sets 2/-, post 4d. All items to construct a crystal set, 10/-, post paid. D.C. **SERIES MOTORS** 12-24-v, 15/20 amps., size 6½in. long, 3½in. dia., fitted 5in. dia. shaft, weight 9lb., a very superior motor, originally cost £10, our price, new, unused, 7/6, post and packing 2/6. Many other bargains; send 3d. with S.A.E. for current lists.

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(3)

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FOR ALL RADIO BARGAINS

0/100 MICROAMP METERS. Brand new 2½in. panel mounting, scaled 0/1,500 yards, 42/6 each.

TRANSFORMERS. All 230 volt A.C. input. 2,000 volt 5 mA., 15/6. 500 x 500 volt 170 mA., 4 volt C.T. 4 amp., 22/6. 250 x 250 volt 150 mA. 4 volt 3 amp., 9/6. 1,500 volt 330 mA., 52/6. 4 volt 14 amp., 6.3 volt 1½ amp., 10/6.

H.R.O. 6 VOLT VIBRATOR POWER PACKS. Output 165 volt 80 mA., 6.3 volt 3 amps., 6 x 5 rectifier, fully smoothed, size 7in. x 7in. x 6in., supplied brand new with clips and leads, 29/6 each.

HEAVY DUTY WIREWOUND POTENTIOMETERS. 400 ohm, 10K ohm, 20K ohm, 6 watts, 3/6 each. 50K ohm, 100K ohm, 10 watts, 7/6 each.

HEADPHONES. Brand new Canadian "Northern Electric" finest ever produced, 50 ohm coils, complete with P.O. Jack Plug, 10/6 pair.

CERAMIC TRANSMITTER SWITCHES. Extra heavy duty silver contacts, 3in. dia., 1 pole, 6 way, 3 bank, 9/6. 1 pole, 6 way, 2 bank, 6/6 each. 1 pole, 4 way, 1 bank, 5/6 each.

P.40 POWER PACKS. Brand new, 200/250 volt A.C. input. Output 175 volts D.C. 60 mA., 12 volts 2 amps., fully smoothed, SZ4 rectifier, 32/6 each.

P.O. MAGNETIC COUNTERS. 0/9999. Supplied with 3 ohm coils for 1.5 volts or 2,300 ohm coils for 18/24 volts D.C., 4/3 each.

METERS. All brand new and boxed.
0-1 mA. 2½in. desk type 25/- each.
0-1 mA. 2½in. round F/M M/coil, 22/6 each.
0-5 mA. 2in. square F/M M/coil, 7/6 each.
0-10 mA. 2½in. round F/M M/coil, 9/6 each.
0-100 mA. 2½in. round F/M M/coil, 9/6 each.
0-150 mA. 2in. square F/M M/coil, 7/6 each.
0-200 mA. 2in. square F/M M/coil, 7/6 each.
0-200 mA. 2½in. round F/M M/coil, 9/6 each.

AMMETERS.
0-1 amp. 2½in. projecting, R.F. 7/6.
0-5 amp. 2½in. round, F/M, R.F., 7/6.
0-10 amp. 2in. square, F/M, M/coil, 8/6.
20/20 amp. 2in. round, F/M, centre zero, 6/6.
0-30 amp. 2in. square F/M M/coil, 7/6.

VOLTMETERS.
0/20 volts 2in. square, F/M, M/coil, 7/6.
0/40 volt 2in. square, F/M., M/coil, 7/6.

A.C. VOLTMETERS 50 CYCLE. 0-15 volt 2½in. round, F/M, M/I, 8/6; 0-20 volt 2½in. round, F/M, M/I, 10/-; 0-300 volt, 2½in. round, F/M, M/I, 25/-; 0-300 volt 5in. projection, M/I, 50/-; 0-300 volts 3½in. round, complete in box with leads and prods, 39/6.

ROTARY CONVERTORS. Models for 12 or 24 volt D.C. input, output 230 volt A.C., 50 cycle, 100/150 watts, 92/6 each.

RF.26 UNITS. Brand new with 3 valves, 29/6 each.

TRANSFORMERS. 230 volts input. 6.3 volts 1½ amps, 6.3 volts 1½ amps., 9/6 each; 300 volts 60 mA., 6.3 volts 1½ amps., 8/6 each.

CAMERA CONTROL UNITS. Type 35 No. 20. 24 volts D.C. operation, brand new, 22/6.

POWER UNITS S.441B. 200/250 volt input. Output 300 volts 200 mA., 12 volts 3 amps. Choke and condenser smoothed, 5U4G rectifier, 62/6 each.

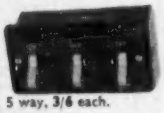
AMERICAN ALL METAL SCREENED POWER RHEOSTATS. 60 ohms 1.5 amps., 7/6 each. 200 ohms, .35 amps., 5/6 each. 8 ohms 2.5 amps., 7/6 each. 60 ohms .9 amps., 7/6 each. 8 ohms, 3.3 amps., 8/6 each.

WANTED—good class communication receivers and test gear, send yours stating reasonable price, cash by return.

R.1155 COMMUNICATION RECEIVERS Brand new in original transit cases. 5 wavebands. The World at your finger tips. £11/19/6 each.

CERAMIC SWITCHES. 3 pole, 4 way, 4 bank, 10/6. 4 pole, 3 way, 3 bank, 6/6. 7 pole, 2 way, 3 bank, 5/6.

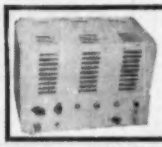
EX-W.D. POWER PACKS. 230 volt A.C. input. Output 150 volts 60 mA., 6.3 volts 1½ amps., fully smoothed, metal rectifiers, 29/6 each.



EX A.M. SWITCH BOXES. Fitted with 3 independent 5 amp switches, size 3½in. x 2in. x 2in., ideal for cars, boats and caravans, 1/9 each. Ditto, 5 way, 3/6 each.

EX W.D. CHOKES. 20 henry 300 mA., 13/6. 20 henry 120/180 mA., 10/6. 15 henry 275 mA., 10/6. 15 henry 80 mA., 5/6. Swinging Chokes 150 mA., 4/20 henry, 7/6 each. 10 henry 150 mA., 9/6.

TELEPHONE HANDSETS. Ex-American, Standard P.O. type, wonderful instruments, 12/6 each.



RECORD AMPLIFIERS. 200/250 volt A.C. input, Push-pull 6V6, 8 watts output, variable tone control, matched output to 3 or 15 ohms. £6/10/- complete.

EX A.M. SWITCH BOXES. Fitted with 16 toggle type switches, ideal for model or train control, brand new and boxed, 9/6 each.

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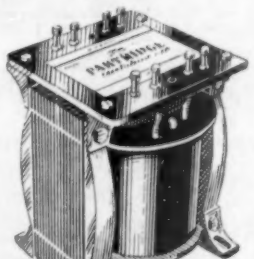

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TR9 transmitter/receivers, battery operated, 1½ m/cs, easily modified to other amateur and marine bands; splendid beginner's station, 47/6, C.P. or "mint" condition, 77/6 C.P.

T1154; the famous R.A.F. transmitters, for use with R1155, complete with valves; from 30/- C.P.

R.F. UNITS, type 24, new with valves, in original cartons; 15/- C.P.

POWER units, type 5, 250v ac input, 250v dc and 6.3v dc output; 30/- C.P.

CONVERTERS 24-volt dc input, 230-volt ac, 50 cyc/s output, 100 watts, 80/- C.P.

SIGNAL generators and test equipment.

BRITISH and U.S. by quotation.

SEND us your specific enquiries; we hold large and varied stock of ex-Air Services radio.

STARAVIA (Disposals Division), Blackbushe Airport, Camberley, Surrey. [3682

WILCOX Gay VFO's, SCR522, 12 volt power packs, British Breeze p/u cartridges and cables 6/12 way, large stock of HF aircraft and VHF Pye mobile radiotelephones, Techrad TR50XM R/T 12-24 volt 50w.—Raymans, 106, Kensington High St., London, W.8. [3633

NEW COMPONENTS

32-point G.P.O.-type shelf jacks and plugs, new; 17/6 pair.—Process Units, Ltd., Skircoat Moor Rd., Halifax. [3785

FM receiver kits; the well-known W.W. design; wound coils, valves, all parts, down to nuts and bolts; elegant stoved chassis, front-plate, kits from £7/5; a new 55-mile feeder, at £5 complete kit, miniature receiver (W.W. Oct. '54), parts set, 70/-, inc. chassis, valves, coil.—Bel Sound Products Co., Marlborough Yard, London, Archway, N.19. [0185

COMPONENTS—SURPLUS AND SECONDHAND

GERMANIUM diodes, 1/- each; quantities 1/- each or.—B.D.C., 591, Green Lanes, London N.8. [3649

FREE list; sensational prices; valve, components.—Jack Porter, Ltd., College St., Worcester. [3296

"AUTOMAT" CHARGERS and POWER PACKS

as supplied to Ministries, Airline Co's, etc., up to 600 watts. Correct design, best materials and workmanship.

Selenium rectifier stacks, 40 ma. to 10 amp., with or without transformers.

"AUTOMAT" SELF REGULATING CHARGERS "Export" model as illus. for 6 v./12 v. 5 amps., using S.T.C. selenium rectifier, damp-proof, ultra reliable, wt. 16lb., for 215/245 v. A.C., 26/5/- carr. 4/6 extra. Gtd. 12 months. Also our well known 12 v. 9 amp. charger with protective ballast and glow indicator, 69/6, ditto, 6 v. 2 amp./12 v. 2 amp., 69/6, ditto, 12 v. 1 amp., 49/6, postage 1/10, wt. 8lb.

FOOLPROOF CHARGER KITS. Genuinely trouble free and ultra reliable. As sold for 11 years through "W.W." with full data sheet and instructions. **No. 1 Kit.** Westalite 3 amp. rectifier, 65 watt tapped, impregnated trans., ballast bulb, for 2 v. 6 v., 12 v. charger, all rectifier troubles eliminated. 46/-., p.p. 1/10. Handsome steel case, ready punched, louvred, enamelled, 12/6. **No. 1A Kit.** 3 a. rectifier, 65 watt trans., ballast. res., ammeter for 2 v., 6 v., 12 v., 3 a., 52/6, p.p. 1/10. **No. 2 Kit.** 12 v. 3 amp. rect., 45 watt trans., ballast/indicator bulb for 2 v., 6 v., 12 v. charger, 36/6. Case 12/6, p.p. 1/10. Wt. 8lb. with case. **Minor Kit** 6 v. 2 amp., 32/-, p.p. 1/10, case 12/6 extra. **Senior Model,** for 6 v./12 v. at 4 to 5 amps., 12 v. 5 amp. S.T.C. rect., 85 watt trans., ballast bulb, 64/-, p.p. 2/-. **Slider Kit,** 120 watts trans., 14 v., 6 amp., large finned type rect., slider res., high grade ammeter, wt. 17lb., for 6 v./12 v. charger, 44/13/-, carr. 4/-.

SELENIUM RECTIFIERS, new stock not surplus, 6v. 1a., 4/-, 2a., 7/6, 4 a., 15/-, 12 v. 0.5 a., 5/-, 1 a., 7/6, 2 a., 9/6, all p.p. 6d. 12 v./14 v. 3 a. to 3.4 a., 15/6, 5 a., 27/-. Large finned 6 a., 32/-, p.p. 10d. 24 v. 50 mA., 2/9. 24 v. 0.5 a., 9/-, 1.5 a., 15/-, 2 a., 27/-, 5 a., 42/-, 8 a., 62/-, all p.p. 10d. 50 v. 1 a., 24/-, 2 a., 47/-. 230 v. 1 a., 97/-, p.p. 1/6. H.T. rectifiers, 120 v. 80 mA. R.M.S., 3/4, 135 v. 30 mA. elim., 5/6, 250 v. 60 mA., 7/-, 250 v. 100 mA. bridge, 14/6. all p.p. 6d. Many other L.T. and H.T. types in stock.

"RENEWBAT" CONDITIONER AND DESULPHATER. Car size, 3/6, p. 8d.

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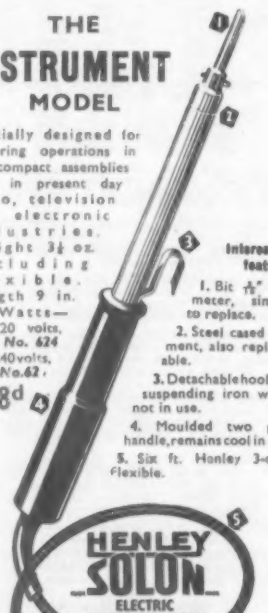
THE

INSTRUMENT MODEL

Specially designed for soldering operations in the compact assemblies used in present day radio, television and electronic industries. Weight 3½ oz. excluding flexible. Length 9 in. 25 Watts—200/220 volts, *LIST No. 624* 220/240 volts, *LIST No.62*, **19/8d**



Interesting features

1. Bit ⅛" diameter, simple to replace.
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COMPONENTS—SURPLUS AND SECONDHAND

SUPREME RADIO, 746b, Romford Rd., Manor Park, London, E.12. TEL. Ilf. 1260, est. 19 years.

DRYLITIC Cond: chassis fitting can type, 32+8+8mfd 275v, 3/3 ea.; also 32mfd 350v, clip fitting, small, our price, 1/9 ea.

JUST arrived! 16+24mfd 350v, 425 surge clip fitting, can cond., bargain price of 2/9 ea.

ANOTHER popular cond. line, carboard w/end 8mfd 450v, at 1/11 ea.

STEEL chassis, grey finish, ready punched for s/het layout, 14in×6in×3in, 2/6 ea.

2-POLE 2-way w/change switches, 1/- ea., 11/- per doz.

HEATER trans. pri. 0-250v, sec. 6.3v, at 1.5 amp., very popular bargain, 5/9 ea.

VOLT/CANTROLS, small type, long spindle, with single pole switch, 1 meg, ½ meg, or ¼ meg, our price 2/6 ea.

CRYSTAL diodes for crystal sets, 1/6 ea.

DUAL range T.R.F. coils, 200 to 2,000 metres, with cores, 5/6 pr

VERY popular mains trans buy; shrouded upright mounting, with base connections, 290-0-290v, 60 m/a, 6.3v 1.5 amp, and 4v 2 amp, with screen; primary, tapped on voltage panel, 0-200v, 220v, 240v, size H. 3½in×3½in×2¾in D, our price 12/6+1/- pack/post.

TERMS c.w.o. No c.o.d.

SEND 9d extra for postage orders under £5. 2½d. S.a.e. all enquiries and list. [0021

RADIO CLEARANCE, Ltd., 27, Tottenham Court Rd., London, W.1. Tel. Museum 9188.

ELECTROLYTICS, capacity, voltage, size, type of mounting, price post paid: 400, 6v, 1×2in, lug, 1/9; 250+250, 6v, 1×2in, lug, 2/-; 40, 150v, 1×2, clip, 2/6; 20+20, 275v, 1×2, lug, 3/3; 16+32, 275v, 1/2, lug, 3/3, 16+16, 275v, 1×2, clip, 3/3; 100, 275, 350v, 1⅛×3, clip, 3/6; 32+12, 350v, 1⅝×2, clip, 2/-; 16+16+16, 350v, 1⅝x2, clip, ⅝×2, 4/9; 16, 350v, ¾×2, lug, 1/9; 40+40, 300v, 1×3, lug, 3/6; 10, 450v, ¾×2, lug, 1/6; 16, 450v, ⅞×2, tag, 2/3; 20, 450v, 1×2, 2/3; 32, 450/525v, 1⅜×2, clip, 3/9; 15+15, 450v+20mf 25v, 1⅛×3, lug, 4/6; 200, 6v, ⅝×1¼, clip, 1/6; 100, 12v, 1×1¼, clip, 1/9; 8, 450v, 1×2, clip, 2/-; 50, 12v, ⅝×1⅝, tag, 1/6; 150, 25v, ¾×1¾, clip, 2/-; 250, 12v, ¾×1¾, wire 2/3; 16+16, 450v, 1⅛×2, clip, 4/-; 40+40, 275v 1⅜×2, clip, 3/3; 24+24+16, 350/425v, 1⅜×2, clip, 4/9; 60+200, 275/350v, 1¾×4½, clip, 6/6; 4, 150v, ⅝×1¾, lug, 1/1; 500, 12v, 1⅜×2⅜, clip, 2/-; 8, 350v, ¾×2, clip, 1/9, 32+32, 350/425v, 1⅜×2, clip, 5/-; 8+16, 450×525v, 1×2, clip, 4/-; 2, 450/525v, ¾×1¾, tag, 1/6; 8, 450v, ⅝×2, clip, 1/9; 32+32, 450/525v, 1¼in×3in, wire ended, 5/6; 64+120, 275v, 1¾×4½, clip, 5/6; 1,000+1,000, 6v, 1×3in, lug, 4/3; all cans, some with sleeves, all voltages, WKG. surge where marked, new stock guaranteed.

TELEVISION! Set of 3 components, comprising line output trans., with E.H.T. winding to give 7kV. using EY51 (heater winding for EY51 also included), and fitted with width control scanning coils, low impedance line and frame, focus coil (res. 10,000Ω, current approx. 20 mA), the set of 3 for 42/-, plus 2/- post. diagram of line trans supplied.

UNIVERSAL amplifiers, 8-valve 20watt A.C./D.C., black crackle chassis, and black and chrome cover, overall size 15½in×7¼in×7in. First-class components (Partridge O.P.T., and driver, Wardner choke, A.R.P. Mu-Metal input trans. for mike) Valves, 2×EF37, 4×CL33, 2×UR3C. Switched input for high or low imp., top cut and bass cut switches, V.C., mains switch, mains plug and socket, 230-250v, isolated chassis, 15Ω output. Wired and tested, ready for use, with valves, brand new, £10/19/6, carr paid

5mA meters, moving coil, bakelite case, 2in square, flush mounting, new, boxed; 7/- post paid.

MAINS trans., 250-0-250v, 80ma, 6.3v, 2.5A, 6.3v, 0.6A, Pri. 0-210-230-250v 12/- post paid. RADIO CLEARANCE, Ltd., 27, Tottenham Court Rd., London, W.1. Tel. Museum 9188. [0015

SOUTHERN RADIO SUPPLY, Ltd., 11, Little Newport Street, London, W.C.2. See our displayed advertisement, page 179. [0016

SPECIAL Television and U.H.F. Chassis offer! We have been very fortunate to secure a limited number of R.1426 chassis (R.1355 less Power Pack) which form the basis of any U.H.F. Receiver. All are new and include 7 SP61 and 1 EA50 valves, 14 Mcs. IF strip and a host of resistors, condensers, etc., our special price, while they last, 15/-, plus 5/- carriage and packing, amazing value! These won't last long.—Walton's Wireless Stores, 48, Stafford Street, Wolverhampton. [0010

TECHNICAL TRADING COMPANY, 181, Lake Rd., Portsmouth. 'Phone 5785. .002 18kv Visconol condensers, 5/-; Sprague and Micamold .1 350v w/end, 6/- per doz; Rexine modern radio cabinets with grill, back, dial, pointer, 10/-; shrouded mains transformers, VOL/ADJ, 260-0-260 100ma, 6.3v 4A, 14/- and 1/- post/pack.; T.V. superhet 7-valve receiver chassis, 5-channel, modern, EF90, etc., valves with complete T.V. circuit, less valves, bargain 27/6; all above unused components; post 6d extra on all parcels; visitors welcomed; 1,000 bargains. [3765

WANTED, EXCHANGE, ETC.

WANTED, ancillary equipment for MN26 Bendix radio compass.—Box 8929. [3784

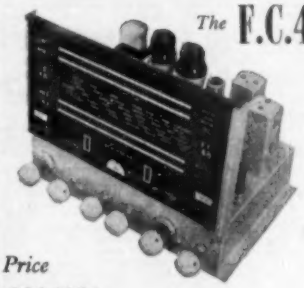
WANTED, makers service sheets for radio and television.—Details, Box 8692. [3697

WANTED, Tuning units, TN17, TN18, TN19, for R54/APR4; £50 each offered.—Box 4963. [0261

THE LATEST

Armstrong RADIOGRAM CHASSIS

The F.C.48



Price

£23/18/- *(inc. P.T.)*

★ 8 VALVES including 2 double Triodes
★ 8 WATTS output from push-pull tetrodes.
★ NEGATIVE FEEDBACK—20 db
★ Provision for F.M. adaptor
★ Independent BASS and TREBLE lift and cut controls with unique THERMOMETER VISUAL INDICATOR
★ 4 WAVE ★ Magic eye tuning

Other chassis in our comprehensive range are:—

RF41, 10 valve, 4 wave, **£31/19/8 (inc. tax) EXP125C,** 14 valve, 5 wave, **£49/10/- (inc. tax),** and two specially designed export models.

The TWIN *Radiogram*

★ ONLY **57** GUINEAS *inc. tax* ★

● 8 VALVES
● TWIN 10" Speakers.
● 3 speed Autochanger
● ARMCHAIR CONTROL by unique "hopper" arrangement.

Our Showroom at the address shown below is open daily from 9 a.m. to 6 p.m. (Saturdays 5 p.m.) and we are always delighted to demonstrate any of our models or supply any information regarding them. If unable to visit us please send for the specifications you may require to Dept WD.

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Telephone : NORth 3213/4

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VHF test equipment.

TS47AP, TS174, TS175/U, TS148 or TSX-45E; analysers; BC221 freq meters, TS69, and any U.S.A. test gear; Klystrons type 723/AB, 2K33, 2K39, 2K41; receiver, APR4 and units TN16, 17-18-19; RCA AR88D, S27 and 8X28s and 327CA; microwave equipment; highest offers given by return.—Ger. 8410. Universal Electronics, 27, Lisle St., Leicester Square, London, W.C.2. [0229

IN23 radar crystals; sale 1155N (trawler band) less valves, 50/-.—Crampins, Grimsby. [3704

WANTED, receivers A.P.R.4, also T.N.16, 17, 18, 19, etc., and any radio test gear. LESLIE DIXON & Co., 214, Queenstown Rd., Battersea, S.W.8. Macaulay 2159. [0176

G.E.C. miniscopes wanted for cash.—Send details of condition and price to Carr, 49, Brudenell Grove, Leeds, 6. [3705

TAPE recorder wanted, good machine essential, two-speed; ful particulars, price.—Walker, 41, Meadow Grove, Olton, Birmingham, 27. [3773

WANTED, HRO coils, Rxs, etc., A.R.88s, BS348s, S27s, etc.—Details to R.T. & I. Service, 254, Grove Green Rd., London, E.11. Ley. 4986. [0163

WANTED, set manufacturers' or ex-Government radio equipment, large or small quantities of valves, electrolytics, speakers, meters, also components.
LOWE BROS., 9a, Diana Place, Euston Rd., N.W.1. Eus. 1636/7.

LOOP aerials of all types required inc. type 17 British; power packs with voltage controllers; valves type 813.—Raymans, 106, Kensington High St., London, W.8. [3633

WEE meggers required, 250v working.—Price and condition to Messrs. Burgot Rentals, Ltd., 33/41, Westbourne Grove, London, W.2 [3757

WANTED, RCA speech amplifiers, type MI-11230, J or K, and aerial tuning units BC939A; offers, stating quantity and price, to—P.C.A. Radio, Beavor Lane, Hammersmith, W.6. [0060

WANTED, small bench mounting spot welder, suitable for welding 0.01in diameter tungsten wire to molybdenum sheet.—Reply to Hilger & Watts, Ltd., 113, Camberwell Rd., S.E.5. [3672

WANTED, BC610 Hallicrafters, ET4336 transmitters, AR88 Ds and LFs, receivers and spare parts for above, also B.C.221 frequency meters; best prices.—P.C.A. Radio, Beavor Lane, Hammersmith, W.6 [0079

URGENTLY wanted, manuals or instruction books, data, etc., on American or British Army, Navy or Air Force radio and electrical equipment.—Harris, 93, Wardour St., W.1. Tel. Gerrard 2504. [3531

SPOT cash waiting for modern used American and British test equipt., communication receivers, transmitters, recorders, amplifiers, converters, etc.; call, write or 'phone Ger. 8562. Try us, we pay top prices.—Leed Radio, 39a, Lisle St., London, W.C.2. [3701

WANTED, signal generators types TF146, TF590Q, TF762A, frequency meters BC221, TS174, TS175; also receivers types AR88, etc., APR4 or similar; send price and details to—Hatfield Instruments, Ltd., 175, Uxbridge Rd., Hanwell, W.7. Tel Ealing 0719/9857. [0037

WANTED, good quality communication RYS tape recorders, test equipment, domestic radios, record players, amplifiers, valves, components, etc., estb. 18 years.—Call, send or 'phone Ger. 4636. Miller's Radio, 35a, Newport Court, Leicester Sq., W.C.2. [3416

VALVES WANTED

ALL types of valves required for cash; state quantity and condition.—Radio Facilities, Ltd., 38, Chalcot Rd., N.W.1. Primrose 9090. [3614

45s paid for 813; also wanted 723, A/B, 805, 803, 2J32, 2K35, TZ40, 808, etc., any quantity.—Write, Pype Hayes Radio, 606, Kingsbury Rd., Birmingham, 24. Erdington 4942. [3575

CABINETS

LEWIS RADIO have the best selection and finest finish.—See page 116. [0224

USED table TV cabinets, £3 and £4.—(Redgates) Royal George Rd., Burgess Hill, Sx. [3691

WALNUT radiogram and television cabinets, soundly constructed; stamp for details.—R. Shaw, 69, Fairlop Rd., Leytonstone, E.11. [3193

CABINETS made to order, bass reflex speaker cabinets all types and finishes; see display advertisement, page 176; open till 5.30 Saturdays.—A. Davies & Co. (Cabinet Makers), 3, Farkhill Place off Parkhill Rd., Hampstead, N.W.3. Gulliver 5775. [3671

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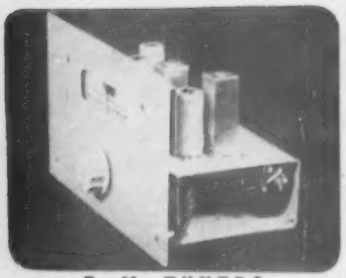
WE urgently require meters of all types, meter components, test equipment, etc.; any quantity, large or small; prompt cash.—ANDERS ELECTRONICS, Ltd., 91, Hampstead Rd., London, N.W.1. Euston 1659 [3736



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Basic Model "A," is thoroughly proven in sensitivity, stability and reliability. Early deliveries are being maintained. These are in use from Bognor to Ely.

Incorporating electrical and mechanical bandspread, unique tapped-down oscillator (crystal stability), and preset matching control. Closely to the Amos & Johnstone design. Additions include a modern hammer-finish frontplate, "3-D" scale, and latest magic eye.

The kit version uses the same new miniature VHF type components. Fully worked chassis is stove enamelled, and wound coated coils are included, it is complete with valves, even nuts and bolts.

F.M. with really sensitive Medium Wave reception is possible with the CB4 double superhet. Incorporates variable de-emphasis, variable matching, ferramic rod aerial, mains power supply. Single or push-pull output can be added. A "hand built" BEL product.

Model "A"	£11 17 6
"A" kit	£7 5 0
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Aerials, 5/- and	£1 10 0
CB4, less output stage, mains driven	£21 0 0
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Hear all these, our new Mullard amplifier and our transistor receiver, at

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short walk Archway stn., 25 mins. from West End.
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New and reconditioned 15 day clockwork and electric switches

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COPPER WIRE

S.W.G.	COTTON-COVERED 2 ozs.	COTTON-COVERED 4 ozs.	SILK-COVERED 2 ozs.	SILK-COVERED 4 ozs.
16	1/4	2/-	1/4	2/-
18	1/4	2/2	1/4	2/2
20	1/5	2/4	1/7	2/8
22	1/6	2/6	1/9	3/-
24	1/7	2/8	1/10	3/2
26	1/9	2/11	2/-	3/6
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32	2/1	3/8	2/7	4/8
34	2/4	4/2	2/11	5/4
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ENAMELLED, TINNED, LITZ, COTTON AND SILK COVERED.
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REWINDS, mains transformers, chokes, E.H.T.s, outputs frame and line opt's fields solenoids, R.F., E.H.T. coils, etc.; new types including "C" cores, designed or to specification; your enquiries will receive prompt attention.—Melton Metallurgical Laboratories, Ltd., Transformer Section, 587-9, Ashley Rd., Parkstone, Poole, Dorset. [3781

ARMATURE rewinding service to the trade, vacuums, drills, grinders, hood dryers, dental motors, vacuum cleaner armatures replaced from stock, 24 hours service; every job guaranteed; we also specialise in complete overhauls and rebuilds of vacuum cleaners; all vacuum cleaner parts, hoses, bearings, fans, brushes for any make in stock.—Regam Electric, 95, Park Lane, Leeds, 1. [0028

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PAINT spraying handbook, 3/6 post free, cellulose and synthetic paints and all spraying requisites supplied; catalogues free.—Leonard Brooks, 53, Harold Wood, Romford. [0207

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TRANSFORMERS, Metro Vick oil filled, 230/18,000 volt 4 kva 50 cycles, brand new ex govt. surplus; to clear £15 each plus 17/6 carriage; or invite offers for 200 lot.—Wireless Instruments (Leeds), Ltd., 54/56, The Headrow, Leeds, 1. Tel. 22262. [3766

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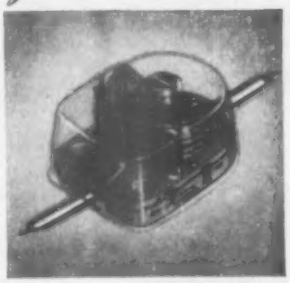

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RADIO Officers required by the EAST Africa High Commission Directorate of Civil Aviation for one tour of 30 to 48 months in the first instance with prospect of permanency. Salary scale (including present temporary allowance of 35% of salary) £742 rising to £985 a year. Gratuity of 13½% of total basic salary drawn during contract for those not taken on permanent establishment. Free passages. Liberal leave on full salary. Outfit allowance £30. Candidates must be capable of operating at 25 w.p.m. and should preferably hold **M.C.A.** 1st Class Certificate in Radio Telegraphy. Knowledge of touch typing for teleprinter, the operation of modern radio or radar aids, or experience in radio maintenance would be an advantage.—Write to the Crown Agents, 4, Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience and quote M2C/30606/WF. [3739

ELECTRONIC Digital Computors.

ELECTRICAL Engineers with an interest in mathematics are required by The English Electric for work on
FAULT Diagnosis, maintenance and development of Digital computors of advanced design.
THESE appointments will be in the Staffordshire Area, and are permanent and pensionable.
HOUSES will be available to successful applicants.—Please reply to Dept. C.P.E., 356/7, Strand, W.C.2, quoting Ref. 1353A. [3639

ELECTRONIC Digital Computors.

MATHEMATICIANS with first- or second-class honours degrees are invited to apply for vacancies in connection with the design and operation of Digital computors of an advanced nature.
APPLICATIONS from people with experience of programming will be especially welcomed.
THESE positions are occurring in the Industrial Electronics Division of The English Electric Co., Ltd., in Staffordshire, and are permanent and pensionable; houses will be available to successful applicants.—Please reply to Dept. C.P.E., 356/7, Strand W.C.2, quoting Ref. 1352A. [3638

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APPLICANTS should write to Personnel Manager, Automatic Telephone and Electric Co., Ltd., Strowger Works, Edge Lane, Liverpool, 7, giving full details of age, qualifications, and experience. [3788

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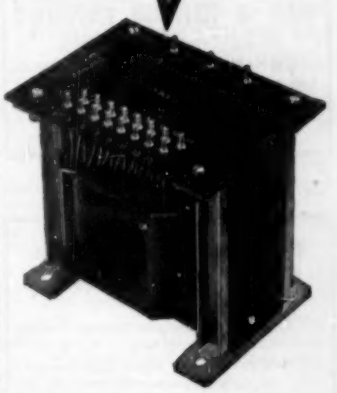
NEWCASTLE UPON TYNE.
FIELD test section of heavy vehicle research dept. has opening for a man with good theoretical knowledge of electronics; minimum educational standard Nat. Cert., City & Guilds Telecommunications Cert., and practical experience of strain gauge circuits, wiring, assembly and testing of electronics apparatus.
GIVE age and fullest details of record, salary, etc.—Write Box 8755. [3706

YORKSHIRE ELECTRICITY BOARD
NO. 1 (Bradford) Sub-Area.
THIRD assistant engineer (radio and television)
APPLICANTS must have had a sound training and experience in the maintenance and repair of various makes of radio and television sets and the duties will include supervision of the sub-area radio service depots carrying out installation, repair and maintenance of apparatus, and will also include responsibility for the training of radio mechanics; the possession of a qualification will be an advantage.
SALARY: N.J.B. class K grade 10 £719/£750 per annum.
APPLICATIONS, giving full details of age, qualifications and experience, together with the names of two referees, should be forwarded to the Manager, No. 1 (Bradford) Sub-Area, Yorkshire Electricity Board, 45-53, Sunbridge Road, Bradford, within 14 days of the appearance of this notice. [3776

They are too good and last too long



"I hope," said one of our customers, after giving us a more lavish amount of praise than usual, "that this letter will not induce you to lower your standards on the grounds that your transformers are too good and last too long."

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Switch design chart sent on request gives more information on possible contact arrangements.

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RAPIDLY expanding company located near Aylesbury offers outstanding opportunity to a Development Engineer with a wide experience of Electronics Design; applicants must have a sound knowledge of communications/pulse technique, be qualified by degree or equivalent, and experience of aerial design would be an advantage; the post offers great scope for future advancement to a man with a good background of industrial or establishment experience; full details of age, experience, qualifications and salary expected to:—AIRTECH, Ltd., Aylesbury and Thame Airport, Haddenham, Bucks. [3769

VACANCIES with Housing Accommodation.

ENGINEERS of Higher National Certificate or degree standard and Students of Ordinary National standard are required at our Hemel Hempstead factory for development work on servo-mechanisms and magnetic amplifiers. PREVIOUS experience is desirable but not essential, applicants with suitable background and interested in this work should apply. Vacancies also available for Mechanical Designers acquainted with this type of work. Prospects of promotion are excellent in this new and expanding laboratory. SUITABLE applicants will have the opportunity of renting a modern house or flat in the New Town. WRITE, as fully as possible, stating your age, experience, to: Dept. B, Box 8269. [3600

TECHNICIAN (broadcasting) required by the GOVERNMENT of Northern Rhodesia Information Department for one tour of 36 months; salary scale (including present temporary allowance of approximately 17% of salary) £674, rising to £1,142; gratuity at the rate of £80/£100 a year; free passages; liberal leave on full salary; candidates, 22 to 35 and with good education, must have had at least two years' practical experience in the maintenance and operation of programme input equipment and/or transmitting equipment with a broadcasting organisation; a knowledge of outside broadcasting, radio frequency and simple workshop practice is desirable and possession of City & Guilds Inter. Certificate in Telecommunications Engineering or equivalent would be an advantage.—Write to the Crown Agents, 4, Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience, and quote M2C/40505/WF. [3709

ASSISTANT Signals Officer required by the SIERRA LEONE Government Civil Aviation Department for one tour 18-24 months, with prospect of permanency; salary scale (including expatriation pay), £742, rising to £1,177 a year; outfit allowance, £60; liberal leave on full salary; free passages for officer and wife; assistance towards cost of children's passages or grant up to £150 annually for maintenance in U.K.; candidates should be experienced in MF, HF, VHF and VHF/DF and ancillary equipment and should hold the P.M.G. Certificate in Wireless Telegraphy or equivalent.—Write to the Crown Agents, 4, Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience, and quote M2C/30853/WF [3678

FERRANTI, Ltd., have immediate vacancies for:—
MEN with electrical engineering qualifications for the advanced testing of fire control equipment involving electronics and servo mechanisms; previous experience of this type of work though desirable is not essential; permanent staff appointments with pension benefits; application forms from Mr. T. J. Lunt Staff Manager, Ferranti, Ltd., Hollinwood, Lancs. PLEASE quote reference HGN. [3767

RACAL ENGINEERING, Ltd., invites application from
SENIOR and Assistant Development Engineers and Mechanical Draughtsmen, preferably with recognized professional qualifications, experienced in various aspects of the design of AIRBORNE Radar Test Gear and R.F. Communication Equipments. Housing will be available to successful applicants after the completion of one month's probationary service, if at present residing in the Greater London Area.—Please forward in writing full details of experience, education, age, etc. to Personnel Officer, Racal Engineering, Ltd., Western Rd., Bracknell, Berks [3661

THE MULLARD RADIO VALVE Co., Ltd., require an
ELECTRONIC engineer to design and supervise the construction of experimental test gear for colour television cathode ray tubes.
APPLICANTS who possess a B.Sc. Hons. degree and have an interest in advanced circuitry techniques are particularly invited to apply.
THIS vacancy is caused by the expansion of the Company's activities in this field. Commencing salary will be according to individual age, experience and qualifications and can be considered as progressive.
THE company's policy regarding the employment of scientific staff provides adequate prospects for advancement; there are facilities for further study and a company pension scheme and progressive holiday plan.
APPLICATIONS in writing will be treated with the strictest confidence and should be addressed to The Personnel Officer, The Mullard Radio Valve Co., Ltd., New Rd., Mitcham Junction, Surrey, quoting reference JFG/A.1/L.7. [3695

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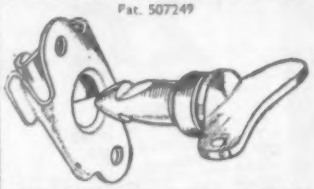

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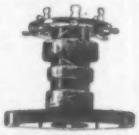

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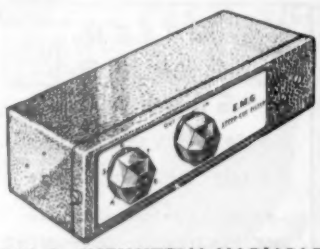

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SITUATIONS VACANT

THE MULLARD RADIO VALVE Co., Ltd., require a

PHYSICIST or Electrical Engineer for its Cathode Ray Tube Department.

THE successful candidate will be expected to carry out investigations and experiments in production techniques, materials and manufacturing equipment. The main emphasis will be upon manufacturing rather than development work.

APPLICATIONS are invited from Physicists or Engineers possessing a B.Sc. degree or equivalent qualifications and previous experience is not essential.

THE vacancy outlined above is caused by the expansion of the Company's activities in this field. Commencing salary will be according to individual age, experience and qualifications and can be considered as progressive.

THE Company's policy regarding the employment of scientific staff provides adequate prospects of advancement and breadth of outlook is assured by opportunities for transfer to other fields of work within the Company.

THERE are facilities for further study and a Company Pension Scheme and progressive holiday plan.

APPLICATIONS in writing will be treated with the strictest confidence and should be addressed to The Personnel Officer, The Mullard Radio Valve Co., Ltd., New Road, Mitcham Junction, Surrey, quoting reference JFG/A.1./M.P.4. [3695

TEST Gear Design Engineers and Maintenance Engineers

REQUIRED with practical experience of this class of work, based on sound knowledge of electronic principles. These vacancies are permanent and progressive. A company pension scheme in operation Lordon area.—Please write, in confidence, giving full details of qualifications to Box 8808. [3725

THE MULLARD RADIO VALVE Co., Ltd., require a

PHYSICIST or electrical engineer for design and development work on cathode-ray tubes for colour television.

PHYSICISTS or engineers who possess a B.Sc. Honours degree and have an interest in electron optics, glass technology or physical chemistry are particularly invited to apply.

THE vacancy outlined above is caused by the expansion of the company's activities in this field; commencing salary will be according to individual age, experience and qualifications and can be considered as progressive.

THE company's policy regarding the employment of scientific staff provides adequate prospects for advancement and breadth of outlook is assured by opportunities for transfer to other fields of work within the company.

THERE are facilities for further study and a company pemion scheme and progressive holiday plan.

APPLICATIONS in writing will be treated with the strictest confidence and should be addressed to The Personnel Officer, The Mullard Radio Valve Co., Ltd., New Rd., Mitcham Junction, Surrey, quoting reference JFG/A.1/M.D.2. [3694

FERRANTI, Ltd., of Wythenshawe, have a number of vacancies for technical assistants in the following fields of investigation:—

HYDRAULIC control mechanisms and Servos.

GYROS.

RELAYS and electro-mechanical instruments.

EXPERIMENTAL vibration testing.

MICRO-WAVE systems.

R.F. circuits.

PULSE circuits.

APPLICANTS should hold a degree or Higher National Certificate in electrical or mechanical engineering.

THE work would be of particular interest to men completing National Service in technical branches of the Services.

The appointments would be to the permanent staff of the company and offer the prospect of interesting work in modern well-equipped laboratories opened in South Manchester within easy reach of residential districts.

THE company operates a staff pension scheme.

APPLICATION forms from Mr. T. J. Lunt, Staff Manager, Ferranti, Ltd., Hollinwood, Lancs.

PLEASE quote reference WTA. [3405

SHORT BROTHERS & HARLAND, Ltd., Belfast, require a laboratory superintendent for their research department.

THE position involves responsibility for providing equipment, supplies and services in the laboratories; also control of laboratory personnel.

CANDIDATES should possess organizing ability, and be familiar with the running of a laboratory or workshop.

EXPERIENCE in light electrical equipment or precision instruments essential.

CONSIDERABLE tenacity and drive necessary to co-ordinate and sustain action with external official bodies.

THIS appointment is suitable for a retired officer of one of the technical branches of the services.

ASSISTANCE with housing, and with removal expenses.

SEND full details of age, qualifications and experience, quoting Ref. 613/Et. App., to Staff Appointments Officer, Short Bros. & Harland, Ltd., P.O. Box No. 241, Belfast. [3344

DEVELOPMENT engineer required for work on R.F. circuitry and associated test equipment; National Service must be completed.

WRITE in first instance, stating experience and salary required, to Sydney S. Bird & Sons, Ltd., Fleets Lane, Poole, Dorset. [3712

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Another Input as above, Output 0, 6, 12, 18, 24 volts at 12 amps., 55/- each, post 2/-. Another Input as above, Output 0, 6, 12, 18, 24 volts, 6/8 amps., 46/6 each.

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EX-RADAR MAINS TRANSFORMERS. Input 230 volts. Output 4 or 5 Kilo-volts at 30 min., also 3 L.T. windings 4 v. 2 a., 6.3 v. 2 a., 2 v. 2 a., these transformers are capable of a larger output than stated and are immersed in oil £3/15/- each, carriage 5/-.

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CONVERTORS, 400 watts output, 24 volts D.C. input, 50 volts 50 cycles 1 phase output. Complete with step-up transformer from 50 volts to 230 volts at 400 watts. £12/10/- each C/F. Ditto 200 watts. £9/10/- each C/F., fully guaranteed.

ROTARY CONVERTORS. 230 volts D.C. input, 230 volts A.C. output. 50 cycles 1 phase at 250 watts. £15 each C/F.

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THE ENGLISH ELECTRIC Co., Ltd., Guided Weapons Division, Luton, has vacancies for all grades of senior and junior staff in the Electronics Department as follows:—
SENIOR engineer with experience of production engineering of prototype electronic equipment and a working knowledge of electronic circuitry.
SENIOR engineer for work on circuit development, and a sound fundamental knowledge of electronics.
SENIOR engineer with a wide experience of radar and communications equipment maintenance.
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SECTION leader to supervise a team of designers and draughtsmen engaged on electronic equipment. Must be familiar with all aspects of RCS 1,000.
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DRAUGHTSMEN for detail design of specialised electronic or electromechanical equipment, and of electrical and electronic laboratory test equipment.
DRAUGHTSMAN checker for work on production drawings of electronic and electromechanical equipment. Must have previous design experience.
CIRCUIT draughtsman or woman for the preparation of circuit and wiring diagrams for electronic equipment, and with a keen interest in electronics and a good knowledge of components.
THESE are permanent and progressive posts, and attractive salaries are offered to the right men. Staff pension after qualifying period.—Applications to Dept. C.P.S., 356-7, Strand, W.C.2, quoting Ref. 1164B. [3666

RADIO engineer required for training on television; keen man only considered; wage according to ability.—Write Box 219, Granthams Advertising, Reading. [3647

TELEVISION engineer required for well-equipped service department; wage £12 per week; only skilled man considered.—Write Box 212, Granthams Advertising, Reading. [3646

TESTERS required for television and radio manufacturers; good rates for experienced men; N.W. London area.—Write for full particulars to Box 7628. [3052

EXPERIENCED television aerial development engineer; test and design to production stage.—Write fully, experience, salary, etc., Box 8454. [3651

REPRESENTATIVES required to call on retailers with popular range of TV tables and multi-purpose cabinets; commission basis.—Box 8927 [3778

AIRCRAFT Radio Mechanics skilled in workshop practice are required by Skyways, Ltd., at Stansted Airport, Essex. Please write to Personnel Manager. [3645

WIRELESS instructor wanted, able to undertake theoretical instruction for P.M.G. Certificates; write fullest particulars, salary expected, etc.—Wireless College, Colwyn Bay. [3713

RADIO and/or television engineer required for bench and outside repairs, driver; references, age, experience, salary expected.—Field's Radio, Ltd., 52, Hall Gate, Doncaster. [3542

TELEVISION field and bench service engineers; basic salary £12/10 per week, plus overtime and car allowance; only fully experienced competent men should apply.—Box 8858 [3741

V.H.F. radio link engineer required for the maintenance of two multi-channel links, previous telephone and radio experience essential.—Apply, giving full details of experience, etc., to:—
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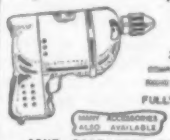

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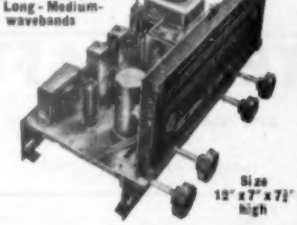

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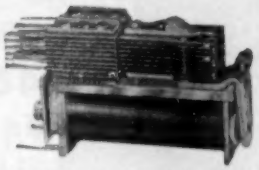

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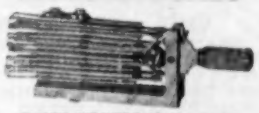

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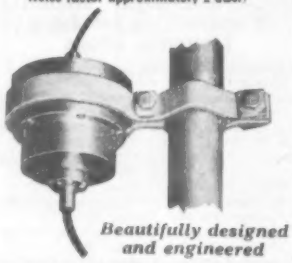
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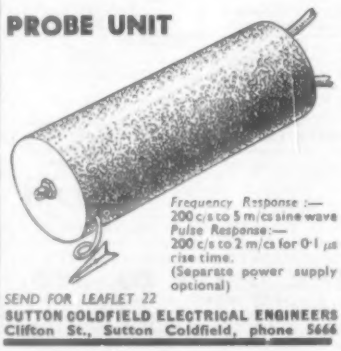
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THE EDISON SWAN ELECTRIC Co., Ltd., have the following vacancies in their Special Products Development Laboratory:—
(1) ENGINEER in charge; engineering degree, or equivalent, with experience of developing electronic equipment ready for factory production.
(2) ENGINEERS able to do original electronic and mechanical development work.
THE work of the laboratory includes development of a wide range of industrial and medical electronic apparatus and instruments.
PLEASE write, stating experience, age, and salary required, to 155, Charing Cross Rd., London, W.C.2. Reference S.P. Lab. [3707

SHORT BROTHERS & HARLAND, Ltd., have a vacancy in their research department for a mathematician to undertake the theoretical investigation of automatic controls, navigational systems, etc.; applicants must possess an Honours degree.
SOME experience of electronic or instrument systems would be an advantage.
GOOD salary and prospects in a rapidly expanding organization; pension scheme; assistance with housing and with removal expenses.
SEND full particulars of age, qualifications and experience to
STAFF Appointments Officer, P.O. Box 241, Belfast, quoting B.A.12. [3707

JUNIOR technical writer required by leading radio valve manufacturer; age approximately 22-25, previous experience in an advertising department an advantage, but not essential; good prospects.—Write, giving full details of age, previous experience, qualifications and salary required to Box 8658. [3687

ASSISTANT production manager wanted for quartz crystal department; must be fully acquainted with all aspects of manufacture and able to take complete charge of a section. Write with full particulars of experience and salary required to Brush Crystal Company, Ltd., Hythe, Southampton. [3696

SALES representatives required by leading industrial electronic heating equipment manufacturer; good electrical and general engineering experience desirable; ability to actually book orders essential; territories London, Birmingham, Cardiff, Bristol, Southampton, Derby and Reading.—Write Box 8657. [3686

RADIO engineer required for British West Africa; applicant must be experienced in servicing radios, record players, P.A. equipment, and have sound electrical experience; also ability control electrical sales and service; single man, maximum age 30 years preferred.—Box 8775. [3711

RADIO and radar testers.—First-class men required for work on V.H.F. communication gear and Government contracts for radio and radar equipment by Midland manufacturers.—Men with wide experience of faults finding in any of the fields mentioned should write, giving full details, to Box 7700. [3470

SENIOR transformer designer required with experience of all types of transformers up to 5,000 kVA; excellent prospects for an energetic man capable of supervising junior engineers, excellent working conditions, pension scheme, canteen, etc.; West London area.—Applications to Box 8135. [3565

RADIO and electronic Laboratory engineer required by North London manufacturers, experience in receiver design and/or transistor technique advantageous; applicants should give fullest details of technical training, qualifications, experience and minimum salary required to—Box 8099. [3550

DECCA RADAR, Ltd., have a vacancy for a Circuit Engineer to work on advanced techniques involving subminiature construction. Previous circuit experience and British nationality essential. Pension scheme. Write quoting reference RLA/65 to Decca Radar, Ltd., 2, Tolworth Rise, Tolworth Surbiton, Surrey. [3728

ASSISTANTS (scientific).—The Civil Service Commissioners invite applications for pensionable posts. Applications may be accepted up to 31st December, 1954, but early application is advised as an earlier closing date may be announced either for the competition as a whole or in one or more subjects. The Interview Board will sit at frequent intervals.
AGE at least 17½ and under 26 years of age on 1st January, 1954, with exemption for regular service in H.M. Forces, but candidates over 26 with specialised experience may be admitted.
CANDIDATES must produce evidence of having reached a prescribed standard of education, particularly in a science or mathematical subject. At least two years' experience in the duties of the class gained by service in a Government Department or other civilian scientific establishment or in technical branches of the Forces essential in one of the following groups of scientific subjects:—
(i) ENGINEERING and physical sciences.
(ii) CHEMISTRY, bio-chemistry and metallurgy.
(iii) BIOLOGICAL sciences.
(iv) GENERAL (including geology, meteorology, general work ranging over two or more groups (i) to (iii) and highly skilled work in laboratory crafts such as glass-blowing).
SALARY £250 (at 18) to £520 (men or £435 (women). Starting pay up to £580 (men) or £340 (women) at 25. Somewhat less in provinces. Opportunities for promotion.
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DESIGN draughtsman. Leading manufacturers require experienced man to take charge of small group responsible for complete engineering of broadcast and television receivers; the post offers considerable scope with good prospects of advancement.—Apply stating age, experience and salary required to The Personnel Manager, Box 8685. [3692

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TELEVISION engineer required by South Wales dealers, fully experienced; all leading agencies held; permanency to single or married man, and accommodation arranged if required; excellent salary.—Apply, giving particulars of experience and salary required, and appointment can be arranged immediately (all letters answered) Box 7585 [3454

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GRADUATES with an honours degree in physics or in electrical engineering are required by the British Thomson-Houston Co., Ltd., Rugby, for research in the field of high-power ultra high-frequency valves; applicants should write to the Director of Research giving their age, qualifications and college, quoting reference DR. [3529

TELEVISION engineers required by old-established company holding every one of the well-known agencies; applicants must be fully experienced and preferably able to drive; top rates and permanent progressive positions to the right men.—Apply to A. S. White & Sons, Ltd., 130/2, High Rd., S. Tottenham, London, N.15. Sta. 7861-2. [3178

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ELECTRONIC Engineers are required for Field Trials on Guided Weapons by the English Electric Co., Ltd., Luton, Beds; applications are invited from men with good electronics experience gained in industry or H.M. Forces, preferably with H.N.C. or equivalent; housing assistance available to successful applicants normally resident in the Greater London Area; applications giving full details of experience and qualifications to—Dept. C.P.S., 536/7, Strand, W.C.2, quoting Ref. No. 1524C. [3770

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GRADUATES with honours degrees in physics or in electrical engineering are required by the British Thomson-Houston Co., Ltd., Rugby, for research in the field of Thyratron development; some knowledge of electronics is desirable. Applicants should write to the Director of Research giving their age, qualifications and college, quoting the reference KB. [3759

GRADUATES with honours degrees in physics or in electrical engineering are required by the British Thomson-Houston Co., Ltd., Rugby, for research in the field of Klystron development; some knowledge of electronics is desirable. Applicants should write to the Director of Research, giving their age, qualifications and college, quoting the reference DR. [3760

MICROWAVE Engineers read. for research and development laboratory at Feltham, Middx. Applicants should have a good academic background with previous experience of microwave problems and design of microwave components. Two vacancies exist, one requiring qualities of leadership.—Applicants should write with full details to Personnel Dept. (ED/201), E.M.I. Eng. Dev., Ltd., Hayes, Middx. [3483

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SENIOR design engineer required for television and radio development work, experience and ability to work on own initiative essential, knowledge of modern production requirements an advantage, salary according to experience and ability, pension fund, junior lab. engineers also required for progressive posts.—Apply, giving details, to Personnel Manager, Pilot Radio, Ltd., Park Royal Rd., N.W.10. [3717

QUALIFIED Electrical Engineer required at Scientific Research Station near Cambridge to undertake semi-experimental work in Laboratory Workshop. Must be willing to be engaged on ordinary electrical plant maintenance and installation work temporarily. Salary range £550—£750 per annum according to age, qualifications and experience.—Write stating age, fullest particulars and salary required to Box 6355. [3631

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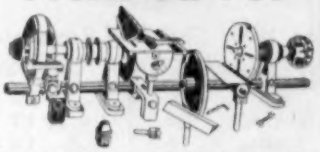

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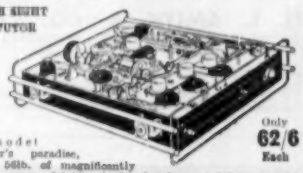

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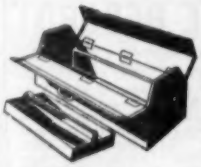

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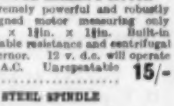

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MEMBERS of H.M. Forces, due for release, with radio or radar experience; places available on different stages of our 5-year course in telecommunications engineering; excellent prospects of employment on completion of training.—For information write, giving details of service training and experience, to E.M.I. Institutes, Dept. WW54S, Pembridge Sq., London, W.2. [3758

TECHNICAL assistants (electronic).—Men required of Final Certificate City & Guilds Telecommunications standard and with experience in V.H.F. and U.H.F.; men with comparable experience in these frequencies can be considered; opportunity to broaden experience and avoid restrictive specialization; Saturday interview if required.—Apply Marconi Instruments, Ltd., Longacres, Hatfield Rd., St. Albans. [3464

RADIO.—Junior laboratory engineer required by North London manufacturers, of good education and technical training, preferably holding or studying for recognised qualifications.—Apply stating fullest details of education, experience and minimum salary required (which latter will be considered in selecting applicants for interview but not to determine the amount offered to successful applicant), to Box 7402. [3383

PRACTICAL electronic engineer required for work on test equipment; should be able to diagnose faults using diagram and technical write-up, calibrate to close tolerances, and work on his own initiative with the minimum of supervision; salary £600 p.a. and above, according to qualifications.—Write, quoting reference 33/kN, to the Personnel Manager, Smiths Aircraft Instruments, Ltd., Bishops Cleeve, near Cheltenham, Glos. [3589

ELECTRICAL mechanic required by the test department of aircraft design to be responsible for setting up, operating and routine servicing of electrical and electronic measuring apparatus; applicants should be familiar with use of oscilloscopes and standard amplifying and measuring equipment, but main qualifications are interest and ability to learn.—Application forms from Chief Clerk, The College of Aeronautics, Cranfield, Bletchley, Bucks. [3780

TECHNICAL/COMMERCIAL Engineer required by electrical manufacturers in Eire for their radio department. Candidates should be between the ages of 25/40 and must have technical experience applied to radio receivers and amplifiers. Candidates, who will be interviewed in London, should write giving age and full details of technical and educational qualifications, previous experience and salary required to Box 8813. [3726

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OXFORD University.—Assistant required for electronic engineer; basic electrical knowledge essential and some electronic experience an advantage; would suit man who has just completed military service; permanent post, pensionable, with 5½-6 weeks' paid holiday per year; salary according to qualifications.—Apply at once giving full particulars of experience to Administrative Officer, Department of Biochemistry, South Parks Rd., Oxford. [3756

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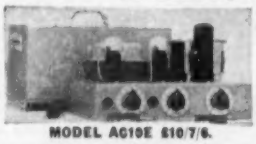

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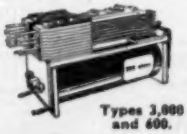

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INDEX TO ADVERTISERS

	PAGE
A.A. Tools	178
Acoustical Mfg. Co., Ltd.	28
Aeru Electric Tool Mfg. Co., Ltd., The	68
Ad. Auriema, Inc.	69
Adcola Products, Ltd.	54
A.D.S. Relays, Ltd.	68
Advance Components, Ltd.	14, 77
Aero Research, Ltd.	27
Airmec, Ltd.	43
Allen Components, Ltd.	167
Allen-Dixon	178
Alpha Radio Supply Co., The	144
Altham Radio Co.	119
Ambassador Radio & Television	60
Amp ex Appliances (Kent), Ltd.	152
Ampilvox, Ltd.	124
Angers Electronics, Ltd.	89
Anglo-American Vulcanised Fibre Co., Ltd.	76
Antiference, Ltd.	81
Appareillage Electrique Schoeller	168
Appointments Vacant	162, 176, 177
Arcolectric Switches, Ltd.	48
Ariel Sound	170
Armstrong Wireless & Television Co., Ltd.	78,165
Ashdown, H.	72
Ashworth, H.	54
Associated Cine Equipments, Ltd.	120
Automatic Coil Winder & Electrical Equipment Co., Ltd., The	1
Automatic Telephone & Electric Co., Ltd.	21
Autoset (Production), Ltd.	68
Bakers "Selhurst" Radio	125
Barker Natural Reproducers	167
Beamish, V. W.	168
Belling & Lee, Ltd.	101
Bell, John, & Croyden	136
Bel Sound Products, Ltd.	166
Benson, W. A.	168
Berry's (Short Wave), Ltd.	86
Birmingham Sound Reproducers, Ltd.	96
B. K. Partners, Ltd.	52, 122
Blickvac	122
Blundell, G.	172
Bradmatic, Ltd.	80
Britain, Chas. (Radio), Ltd.	157
British Communications Corpn., Ltd.	51
British Distributing Co.	172
British Institute of Engineering Technology	172, 179
British Insulated Callender's Cables, Ltd.	Cover ii
British National Radio School	162
British Physical Laboratories	74, 117
British Sarozal, Ltd.	162
Brookes Crystals, Ltd.	84
Brown, S. G., Ltd.	66
Bulgin, A. F. & Co., Ltd.	Edit. 629
Bullers, Ltd.	48
Bull, J., & Sons	134
Candler System Co.	169
Cape Electrophonics, Ltd.	164
Cathodeon Crystals, Ltd.	116
Cementation (Muffelite), Ltd.	74
Chaffey Cabinet Co.	170
Champion Products	164
Chapman, C. T. (Reproducers), Ltd.	64
Cinema Television, Ltd.	85
City Sale & Exchange, Ltd.	132
Classic Electrical Co., Ltd.	91
Clydesdale Supply Co.	160
Clyne Radio, Ltd.	150, 151
Cohen, D.	154, 155
Cosmocord, Ltd.	100
Cossor, A. C., Ltd.	29, 105
Coventry Radio	181
Cranston, Alan	174
Davies, A., & Co.	178
Davis, Jack (Relays), Ltd.	80
Denco (Clacton), Ltd.	56
Direct T.V. Replacements	126
Dixon, L., & Co.	180
Donohoe's (Timers)	166
Dubilier Condenser Co. (1925), Ltd.	65
Duke & Co.	175
Dulci Co., Ltd., The	173
Dun-Sobieson Electrical Co.	180
Easco Electrical, Ltd.	181
Edison Swan Electric Co., Ltd.	22, 31, 108
Electrical Instrument Repair Service, The	172
Electro-Acoustic Developments	179
Electro-Acoustic Industries, Ltd.	30
Electro Methods, Ltd.	25
Electronic Laminations, Ltd.	118
Electronic Precision Equipment	112, 113, 114, 115
Electro-Winds, Ltd.	158
E.M.G. Handmade Gramophones, Ltd.	171
E.M.I. Factories, Ltd.	12, 13, 82
E.M.I. Institutes	39, 67, 110
E.M.I. Sales & Service, Ltd.	103
English Electric Valve Co., Ltd.	36
Enthoven Solders, Ltd.	49
Ever Ready Co. (Gt. Britain), Ltd., The	18
E.W.A.	174
Exoel Sound Services, Ltd.	90
Ferranti, Ltd.	4
Filmer, J. T.	174
Fisher Electronics Co., Ltd.	44
Foyle, W. & G., Ltd.	138
Franklin, H.	175
Frith Radiocraft, Ltd.	172
Furnikit	62
Pursehill Laboratories, Ltd.	121
Galpins	171
Gardners Radio, Ltd.	128
Gee Bros., Radio, Ltd.	154
General Electric Co., Ltd.	75
Glaser, L., & Co.	181
Glover, W. T., & Co., Ltd.	90
Goodmans Industries, Ltd.	57, 79
Goodsell, Ltd.	52
Gramophone Co., Ltd., The	102
Gray, Arthur, Ltd.	136
Gresham Transformers, Ltd.	61
Griffiths Hansen (Recordings), Ltd.	178
Grundig (Gt. Britain) Ltd.	133
Hall Electric Ltd.	137
Hanney, L. F.	89
Harris, P.	164
Hartley, H. A., Co., Ltd.	123
Hatfield Radio	136
Henley's, W. T., Telegraph Works Co., Ltd.	164
Henry's	159
Hifi, Ltd.	130
Hivac, Ltd.	129
Holley's Radio	138
Homelab Instruments, Ltd.	127
Household Electrix, Ltd.	127
H.P. Radio Services, Ltd.	76
Hudson Electronic Devices, Ltd.	15
Hunt, A. H. (Capacitors), Ltd.	2
Hunton, Ltd.	66
Iliffe Books	76, 95, 120, 139
Industrial Electronics	125
International Correspondence Schools	70
Jackson Bros. (London), Ltd.	120
Jason Motor & Electronic Co.	175
K. & K. Electrical Supplies	136
Kaye Electrical Mfg. Co.	132, 181
Kempner, S.	78
Kenroy, Ltd.	171
Keyswitch Co., The	72
Kolectric, Ltd.	84
Koskie, B.	134
Lafco Compounds, Ltd.	179
Lancaster Hi-Fidelity Acoustical Equipment Co.	174
Lasky's Radio	145, 146, 147
Leak, H. J., & Co., Ltd.	111
Lee Products (Gt. Britain), Ltd.	70
Leevers-Rich Equipment, Ltd.	74
Lewis Radio Co.	116
Light Soldering Developments, Ltd.	180
Lockwood & Co.	17
London Central Radio Stores	172
Lowther Mfg. Co.	129
L. R. Supply Co., Ltd.	119
Lyons, Claude, Ltd.	90
Lyons Radio	181
Magnetic Coatings, Ltd.	44
Magnetic Devices, Ltd.	53
Mail Order Supply Co.	33, 34, 35
Malvyn Eng. Co.	174
Marconi Instruments, Ltd.	36
Marconi's Wireless Telegraph Co., Ltd.	104, 109
Martin, J. H.	170
Massey, R.	166
McElroy-Adams Mfg. Group, Ltd.	118
McGraw-Hill Publishing Co., Ltd.	126
McMurdo Instruments Co., Ltd.	131
Midland Instrument Co.	160
Miers, N., & Co., Ltd.	130
Minnesota Mining & Manufacturing Co., Ltd.	135
Modern Book Co.	175
Modern Electrics, Ltd.	126
Modern Sound Equipments	174
Modern Techniques	86
Morley Transformers	174
M.R. Supplies, Ltd.	86
M.S.S. Recording Co., Ltd.	20
Mullard, Ltd.	3, 7, 26, 62, 98
Multicore Solders, Ltd.	Cover iv
Multitone Electric Co., Ltd.	123
Murex, Ltd.	60
Northern Radio Services	46, 47
Norton & Gregory, Ltd.	10, 11
Oddie, Bradbury & Cull, Ltd.	170
Osmor Radio Products, Ltd.	32
Oxley Developments Co., Ltd.	166
Painton & Co., Ltd.	63
Parker, A. B.	130
Parsonage, W. F., & Co., Ltd.	170
Partridge Transformers, Ltd.	163
P.C.A. Radio	158
Pearce, T. W.	168
Pettifor Bros., Ltd.	172
Philips Electrical, Ltd.	133
Plasticable, Ltd.	130
Plessey Co., Ltd., The	59
Post Radio Supplies	166
Power Controls, Ltd.	8, 9
Pratt's Radio	181
Premier Radio Co.	92, 93, 94, 95
Proops Bros., Ltd.	153
Pye, Ltd.	24, 41, 83
Pye, W. G., & Co., Ltd.	67
Quality Equipment Designers, Ltd.	137
Quartz Crystal Co., Ltd.	168
Radford Electronics, Ltd.	58
Radio & Electrical Mart, The	160
Radio Corporation of America	89
Radio Kits, Inc.	181
Radio Resistor Co., Ltd., The	42
Radio Servicing Co.	135
Radiospares, Ltd.	178
Radio Supply Co.	148, 149
Radio Traders, Ltd.	158
Rawplug Co., Ltd., The	56
Reproducers & Amplifiers, Ltd.	45
Roding Laboratories	134
Rogers Development Co.	6
Rollet, H., & Co., Ltd.	168
Runbaken Electrical Products	181
Salford Electrical Instruments, Ltd.	64
Sallis, A. T.	181
Samsons Surplus Stores	156
Sapphire Bearings, Ltd.	25
Savage Transformers, Ltd.	169
Scientific Instrument Co.	181
Service Radio Spares	162
Sherman's Supply Co.	177
Sifam Electrical Instruments Co., Ltd.	62
Simmonds, L. E., Ltd.	124
Simon Sound Service	124
Smith, G. W. (Radio), Ltd.	161
Smith, H. L., & Co., Ltd.	178
Smith, W. H., & Sons, Ltd.	136
Sound Sales, Ltd.	110
Southern Radio Supply, Ltd.	179
Specialist Switches	170
Spencer-West	174
Spicers, Ltd.	82
Standard Telephones & Cables, Ltd.	67, 99, 106
Star Metal Plate Works	178
Steatite & Porcelain Products, Ltd.	16
Stern Radio, Ltd.	140, 141, 142, 143
Stewart Transformers, Ltd.	72
Stratton & Co., Ltd.	66
Suflex, Ltd.	75
Sugden, A. R., & Co. (Engineers), Ltd.	75
Supacoils	70
Superior Radio Supplies	169
Sutton Coldfield Electrical Engineers	132
Swan Electronics	174
Tannoy Products, Ltd.	178
Taylor Electrical Instruments, Ltd.	57
Telecraft, Ltd.	55
Telegraph Condenser Co., Ltd.	174
Telemechanics, Ltd.	Cover iii
Tele-Radio (1943), Ltd.	118
Teletron Co., The	64
Trianon Electric, Ltd.	170
Trix Electrical Co., Ltd.	70
Truvox, Ltd.	Edit. 627
	50
Uncles, Bliss & Co., Ltd.	88
Unitelex (London), Ltd.	128
Universal Book Co.	166
Universal Electrical Instruments Corpn.	152
Universal Electronics	139
Valradio, Ltd.	122
Venner Accumulators, Ltd.	117
V.E.S., Wholesale Services, Ltd.	138
Vitavox, Ltd.	58
Vortexion, Ltd.	107
Waveforms, Ltd.	19
Wayne Kerr Laboratories, Ltd., The	71
Webber, R. A., Ltd.	138
Webb's Radio	181
West End Radio, Ltd.	172
Westinghouse Brake & Signal Co., Ltd.	68
Wharfedale Wireless Works	131
Whitaker, H.	154
Whiteley Electrical Radio Co., Ltd.	40
White, S. S., Co. of Gt. Britain, Ltd., The	50
Whittemore, A. J. (Aeradio), Ltd.	181
Wilkinson, L.	173
Willesden Transformer Co., Ltd.	78
Wilson, R., & Co.	170
Woden Transformers, Ltd.	121
Wolf Electric Tools, Ltd.	116
Woolleys Radio & Electrical Supplies, Ltd.	156
Wright & Weaire, Ltd.	5
Young, C. H.	158
Z. & I. Aero Services, Ltd.	136

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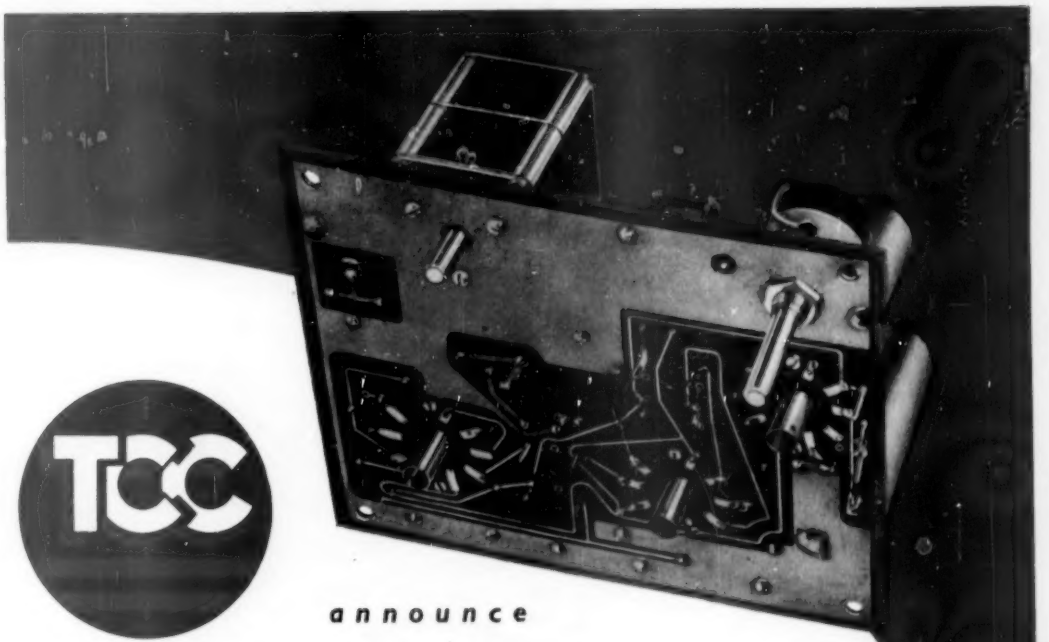

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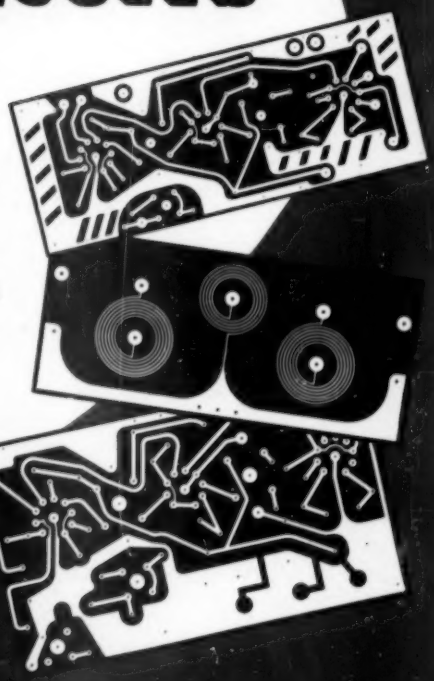

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